

CHAPTER 4

HABITATS OF GREATEST CONSERVATION NEED

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Chapter 4

Habitats of Greatest Conservation Need

4.1 Introduction and Overview

This chapter discusses the habitats and community types essential to the conservation of Species of Greatest Conservation Need (SGCN) in Washington. It overviews the status and condition of those habitats, lists key stressors and research needs, and highlights actions to ensure their conservation. The information provided in this chapter addresses Elements 2, 3, and 4 of the eight required to be included in the State Wildlife Action Plan. In this document, “species” is used to refer to species, subspecies, evolutionarily distinct units (ESU), and distinct population segments (DPS).

Three guiding principles informed and shaped the discussion of habitats in the SWAP:

1. *Using a coarse filter/fine filter approach to leverage conservation investment*

Our framework uses both a coarse filter (vegetation formation) and a fine filter (ecological system) to address the conservation needs of individual species, but also importantly, to leverage conservation investment by identifying where on the landscape habitat conservation actions can benefit multiple SGCN .

2. *Adopting standardized classifications to represent habitat*

The SWAP associates SGCN with two vegetation levels using standard vegetation classification: vegetation formations as described in the National Vegetation Classification System; and ecological systems, as described by NatureServe. These two vegetation levels provide the coarse filter (formation level) and fine filter (ecological system level) for distinct vegetative communities. The ecological systems for marine environments are described using the Coastal and Marine Ecological Classification Standard for nearshore, offshore, and oceanic ecological systems. These systems are subdivided by geographic regions of Puget Sound and the outer coast of Washington. The SWAP also associates SGCN with what are considered cultural or human created habitats (urban environments, agricultural fields, managed timberlands).

The use of these standardized classifications will facilitate cross referencing of conservation needs and objectives across state and international borders, promote collaborative efforts with other organizations, and provide access to enhanced mapping tools and products.

3. *Focusing on collaborative, on-the-ground conservation action*

Recognizing that all conservation entails collaboration and multiple partners, WDFW oriented this work with an eye towards being able to identify where habitat conservation priorities identified through the SWAP are shared by other entities, and where on the landscape are the most productive places to achieve on-the-ground conservation.

Chapter Organization

This chapter begins with a few “at a glance” tables and summaries of the key features of the habitats discussed in the SWAP. Table 1 shows the full list of ecological systems found in Washington, and highlights those addressed in this chapter. Table 2 shows marine ecological systems in Washington, as defined for the SWAP. Table 3 summarizes information about the vegetation formations and Table 4 shows the

relationship between ecoregions, vegetation formations, and ecological systems of concern. Ecoregions are broad areas that share similar flora and fauna, geology, hydrology, and landforms. Table 5 provides a summary of stressors present in the vegetative formations and ecological systems of concern.

The next section includes an overview fact sheet for each of the 17 vegetation formations found in Washington, representing the coarse filter scale – Figure 1 shows the distribution of these vegetation formations throughout Washington. These fact sheets provide an overview of the vegetation and distribution and an assessment of condition from ecological integrity assessments conducted by the Washington Natural Heritage Program. They also summarize the number of Species of Greatest Conservation Need that have close association with that vegetation formation, and those that have general association. These fact sheets indicate the number of ecological systems of concern, major stressors to the vegetation formations (including climate change, if appropriate), examples of actions needed to provide and maintain habitat for SGCN, and key research and data needs.

More detailed information is provided for the most imperiled ecological systems within each vegetation formation, representing the fine filter scale. In many cases, conservation attention will need to be focused at this scale to conserve highly vulnerable SGCN or the ecological values represented through the system.

The information for ecological systems of concern includes Natural Heritage Program rank, status and trend, a list of species closely and generally associated with the ecological system of concern and, if there is one, the name that refers to this habitat type, generally, in the WDFW Priority Habitats and Species (PHS) Program. Stressors, and actions to address stressors, are also summarized and discussed.

The final section of the chapter discusses how the conservation needs discussed in this chapter can be applied to on-the-ground conservation through our Priority Landscapes Initiative.

References can be found in Section 4.6, and an explanation of terms and abbreviations used in the chapter can be found in Section 4.5.

Why use Ecological Systems?

Ecological systems are ecological units useful for standardized mapping and conservation assessments of habitat diversity and landscape conditions. They have been adopted nation-wide by many organizations as a vehicle for considering relationships to fish and wildlife species. Each ecological system type describes complexes of plant communities influenced by similar physical environments and dynamic ecological processes such as fire or flooding (NatureServe <http://www.natureserve.org/conservation-tools/terrestrial-ecological-systems-united-states>). Vegetation formations and ecological systems within Washington are mapped and maps are maintained and updated by Washington Department of Fish and Wildlife. Because ecological systems provide clear descriptions of vegetation structure and type, and can be identified on the ground and mapped, they have tremendous value in assessing and determining the quality of wildlife habitat.

Ecoregions

This chapter also references the locations of formations and ecological systems by ecoregion. Ecoregions are based on broad patterns on the landscape and can provide another useful scale and spatial context for conservation planning. Further, several national and state based organizations use ecoregions in various planning initiative and crosswalks between ecological systems, formations and ecoregions can help to

support collaborative efforts. There are 63 ecoregions delineated in North America, and nine of these ecoregions occur partly or completely within Washington (Figure 2.1).

Figure 4-1: Ecoregions in Washington



Methodology

Associating species with ecological systems

Species of Greatest Conservation Need were associated with their use of ecological systems and vegetation formations to determine the relative values of each to wildlife. This step was a central and necessary component of our approach to defining and prioritizing habitats and community types important for species conservation. However, in doing so we recognized that using an ecological system based approach for habitat association purposes might not account for specific vegetative conditions (old-growth forest, for example), that can be critical components of habitat suitability. Ecological systems describe vegetation communities but do not account for ecological condition of those systems, or presence of habitat features (such as cavities in snags) that may be critical to wildlife. To address this, we included specific habitat features important to SGCN in each of the species fact sheets (see Appendix A), and included some of the most important habitat needs in the ecological system fact sheets included in this chapter.

We also noted that there has been almost no effort to formally describe the association of wildlife species with ecological systems. In the absence of published literature, we opted to apply the principles of habitat use and preference to determine varying levels of association with a particular system. Incorporating these levels of relative habitat value made the data useful for multiple types of analyses. We associated species and systems with four categories: closely associated, generally associated, unsuitable, and unknown. These associations are defined below.

1. Closely Associated. The species demonstrates preference for the ecological system, as indicated by greater occurrence, high densities, greater reproductive output, or other indicators of preference, as compared to other ecological systems. A species that is closely associated with individual ecological systems often relies on one to a few ecological systems for a significant part, or all, of its life history requirements.

2. Generally Associated. The species occurs in, but does not prefer, the ecological system, as indicated by relatively low occurrence or densities, or other indicators of a general relationship with the ecological system. A species that is generally associated with individual ecological systems can typically rely on numerous ecological systems to meet its life history requirements.

Note: A species can be closely associated with some ecological systems and generally associated with others, due to differences in occurrence, densities, reproductive output, or other indicators of preference.

3. Unsuitable. The species demonstrates no use or only occasional use of an ecological system.

4. Unknown. The species' use of the ecological system is unknown. There were questions or uncertainty whether or not a species used an ecological system.

Assessments were based upon our current understanding of information such as distribution, range, abundance, and density. Assessments were often based on an individual's knowledge of occurrence in Washington or nearby states and provinces and reflected best professional judgement given the lack of published biological information on these associations. For situations where ecological systems are currently functioning differently than they have historically, we associated species based on our understanding of the former functionality of the ecological system.

It is important to note that a species can be closely associated with habitats within an ecological system in which it is only generally associated. For example, spotted owls are closely associated with forests with complex structure (e.g. mature and old-growth forest), but are only generally associated with multiple ecological systems within their range. In this case, association with ecological systems does not reflect the specific habitat requirements or needs of the species.

For recovering species, we made associations with ecological systems based on an anticipated association during or following recovery. For some species, an association with one or more ecological system(s) may dramatically over-represent current distribution, as they may be associated with extremely small areas within the ecological system. For this reason, it must also be understood that the distribution of the ecological system does not imply that the SGCN is present everywhere that the ecological system is found. For certain species, including many slugs and snails, distribution, abundance, species needs, and habitat conditions are not well known, and that lack of knowledge made the determination of their association with ecological systems difficult.

Identifying Ecological Systems of Concern

We identified Ecological Systems of Concern based on the conservation status rank of each ecological system. The Washington Natural Heritage Program assigned conservation status ranks to Washington's ecological systems using NatureServe's Conservation Status Rank calculator. The Conservation Status Rank is a measure of an ecological system's elimination risk. The rank is calculated using a measure of eight core factors relevant to risk assessment of elimination. The factors are organized into three categories: rarity, threats, and trends. Factors are scaled and weighted and subsequently scored according to their impact on risk. Scores are combined by category resulting in an overall calculated rank, which is reviewed by the

evaluator, and a final conservation status rank is assigned. The Conservation Status Rank calculator automates the process of assigning conservation status ranks across the network thereby improving standardization of rank assignments. WDFW identified systems with S1, S1S2, and S2 ranks as Ecological Systems of Concern.

Identifying Vulnerability to Climate Change

Vulnerability to climate change was assessed by evaluating both inherent sensitivity to climatic changes and the degree of change the ecological system is likely to experience. We assigned a rank to each of the ecological systems of concern, ranging from low, moderate or high, and incorporated climate change into the discussion of key stressors for each of the vegetation formations and ecological systems, when appropriate. See Chapter 5 for more discussion on the methodology and full results of this ranking.

References for introduction (complete list at end of chapter)

- Faber-Langendoen, D., J. Nichols, L. Master, K. Snow, A. Tomaino, R. Bittman, G. Hammerson, B. Heidel, L. Ramsay, A. Teucher, and B. Young. 2012. NatureServe Conservation Status Assessments: Methodology for Assigning Ranks. NatureServe, Arlington VA.
- Federal Geographic Data Committee. 2008. National Vegetation Classification Standard, Version 2. FGDC-STD-005-2008.
- Federal Geographic Data Committee. 2012. Coastal and Marine Ecological Classification Standard. FGDC-STD-018-2012.
- Master, L., D. Faber-Langendoen, R. Bittman, G. A. Hammerson, B. Heidel, J. Nichols, L. Ramsay, and A. Tomaino (2009). NatureServe conservation status assessments: factors for assessing extinction risk. *NatureServe, Arlington, Virginia*.
- Rocchio, J. and R. Crawford. 2008. Draft Field Guide to Washington’s Ecological Systems. Washington Department of Natural Resources.


4.2 SUMMARY OF KEY HABITAT FEATURES

The following tables present summary information regarding distribution, SGCN association and key stressors and actions for each of the Ecological Systems of Concern:

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Vegetation Formations and Terrestrial Ecological Systems Found in Washington

All major habitat types occurring in Washington are described and discussed in this chapter, with a focus on the values they provide for wildlife (see Figure 4-1 for a map of the distribution of the vegetation formations throughout Washington). Highlighted ecological systems of concern are discussed in greater detail within each formation; either because they are imperiled and/or because they are of particularly high conservation value to fish and wildlife.

 Ecologically imperiled and/or important to the conservation of SGCN (these systems are profiled in this chapter)

* High vulnerability to climate change (see Chapter 5 for more information)

Table 4-1: Vegetation Formations and Ecological Systems Found in Washington

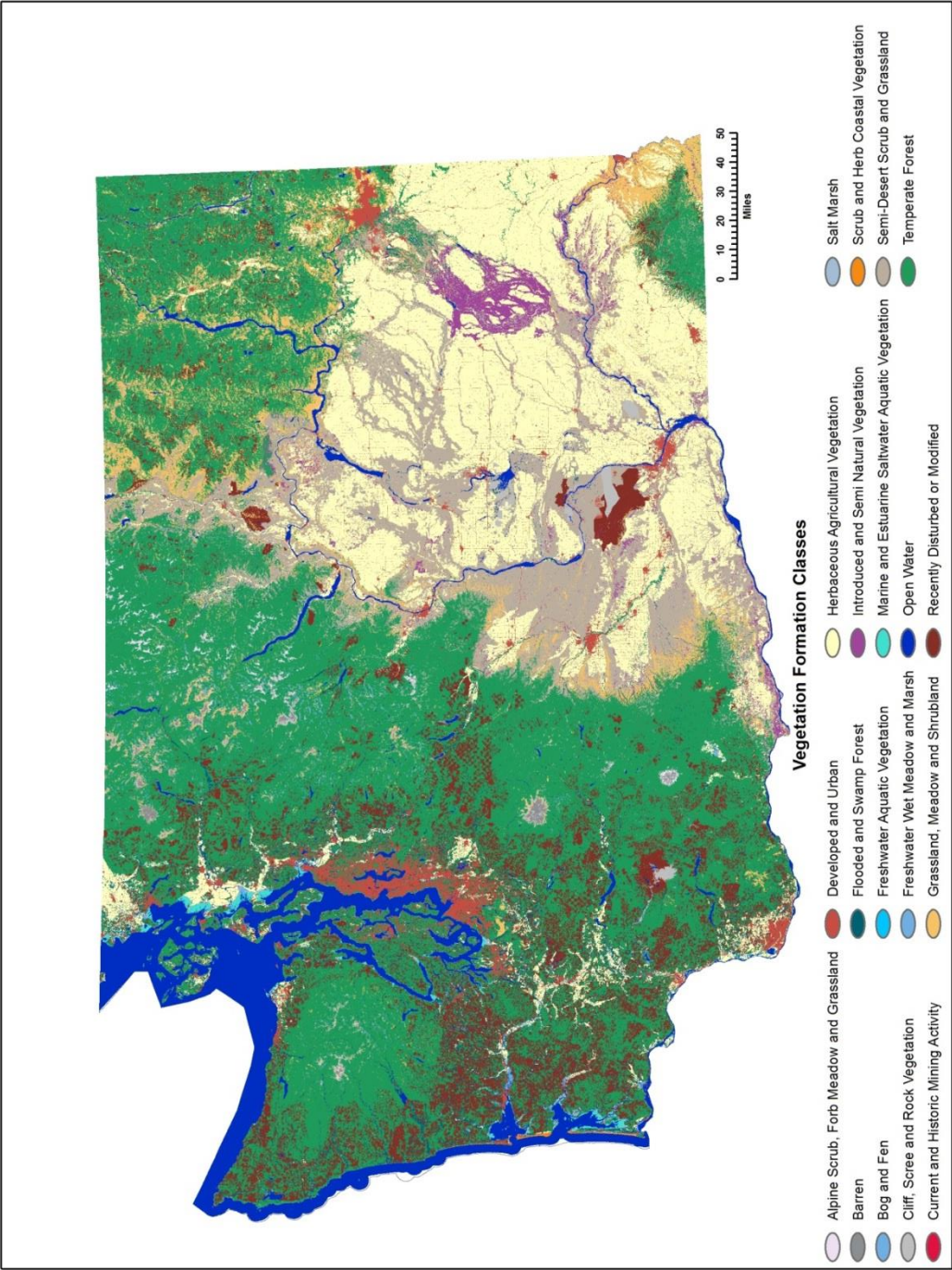
VEGETATION FORMATION	TERRESTRIAL ECOLOGICAL SYSTEM
Alpine Scrub, Meadow & Grassland	North Pacific Dry and Mesic Alpine Dwarf-Shrubland, Fell-field and Meadow Rocky Mountain Alpine Dwarf Shrubland, Fell-field and Turf
Barren	North American Alpine Ice Field Unconsolidated Shore
Bog & Fen	*North Pacific Bog and Fen Rocky Mountain Subalpine-Montane Fen
Cliff, Scree & Rock Vegetation	Inter-Mountain Basins Active and Stabilized Dune Inter-Mountain Basins Cliff and Canyon North Pacific Active Volcanic Rock and Cinder Land North Pacific Alpine and Subalpine Bedrock and Scree North Pacific Montane Massive Bedrock, Cliff and Talus North Pacific Serpentine Barren Rocky Mountain Alpine Bedrock and Scree Rocky Mountain Cliff, Canyon and Massive Bedrock
Developed & Urban	Developed, High Intensity Developed, Low Intensity Developed, Medium Intensity Developed, Open Space
Flooded and Swamp Forest	*Columbia Basin Foothill Riparian Woodland and Shrubland Great Basin Foothill and Lower Montane Riparian Woodland & Shrubland Inter-Mountain Basins Montane Riparian Systems North Pacific Hardwood-Conifer Swamp North Pacific Lowland Riparian Forest and Shrubland North Pacific Montane Riparian Woodland and Shrubland North Pacific Shrub Swamp Northern Rocky Mountain Conifer Swamp *Northern Rocky Mountain Lower Montane Riparian Woodland & Shrubland Rocky Mountain Lower Montane Riparian Woodland and Shrubland

VEGETATION FORMATION	TERRESTRIAL ECOLOGICAL SYSTEM
	Rocky Mountain Subalpine-Montane Riparian Woodland
Freshwater Aquatic Vegetation, Wet Meadow, & Marsh	*Columbia Plateau Vernal Pool
	North American Arid West Emergent Marsh
	North Pacific Avalanche Chute Shrubland
	North Pacific Intertidal Freshwater Wetland
	Rocky Mountain Alpine-Montane Wet Meadow
	Rocky Mountain Subalpine-Montane Riparian Shrubland
	Temperate Pacific Freshwater Aquatic Bed
	Temperate Pacific Freshwater Emergent Marsh
	Temperate Pacific Freshwater Mudflat
	Temperate Pacific Montane Wet Meadow
	Willamette Valley Wet Prairie
Grassland, Meadow and Shrubland	Columbia Basin Foothill and Canyon Dry Grassland
	Columbia Basin Palouse Prairie
	North Pacific Alpine and Subalpine Dry Grassland
	North Pacific Herbaceous Bald and Bluff
	North Pacific Hypermaritime Shrub and Herbaceous Headland
	North Pacific Montane Shrubland
	Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland
	Northern Rocky Mountain Montane-Foothill Deciduous Shrubland
	Northern Rocky Mountain Subalpine Deciduous Shrubland
	Northern Rocky Mountain Subalpine-Upper Montane Grassland
	Rocky Mountain Subalpine-Montane Mesic Meadow
	Willamette Valley Upland Prairie and Savanna
Herbaceous Agricultural Vegetation	Cultivated Cropland
	Pasture/Hay
Introduced & Semi Natural Vegetation	Introduced Riparian and Wetland Vegetation
	Introduced Upland Vegetation - Annual Grassland
	Introduced Upland Vegetation - Perennial Grassland and Forbland
	Introduced Upland Vegetation - Shrub
	Introduced Upland Vegetation - Treed
Open Water	Open Water (Fresh)
Recently Disturbed or Modified	Disturbed non-specific
	Harvested Forest - Grass/Forb Regeneration
	Harvested Forest - Northwestern Conifer Regeneration
	Harvested Forest-Shrub Regeneration
	Recently Burned Forest
	Recently Burned Grassland

VEGETATION FORMATION	TERRESTRIAL ECOLOGICAL SYSTEM
	Recently Burned Shrubland
Salt Marsh	Inter-Mountain Basins Playa and Alkaline Closed Depression Inter-Mountain Basins Greasewood Flat Temperate Pacific Tidal Salt and Brackish Marsh
Scrub and Herb Coastal Vegetation	North Pacific Coastal Cliff and Bluff North Pacific Maritime Coastal Sand Dune and Strand
Semi-Desert Scrub & Grassland	Columbia Plateau Low Sagebrush Steppe Columbia Plateau Scabland Shrubland Columbia Plateau Steppe and Grassland Inter-Mountain Basins Big Sagebrush Shrubland *Inter-Mountain Basins Big Sagebrush Steppe Inter-Mountain Basins Mixed Salt Desert Scrub Inter-Mountain Basins Montane Sagebrush Steppe Inter-Mountain Basins Semi-Desert Grassland Inter-Mountain Basins Semi-Desert Shrub Steppe
Temperate Forest	Columbia Plateau Western Juniper Woodland and Savanna East Cascades Mesic Montane Mixed-Conifer Forest and Woodland East Cascades Oak-Ponderosa Pine Forest and Woodland Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland Middle Rocky Mountain Montane Douglas-fir Forest and Woodland North Pacific Broadleaf Landslide Forest and Shrubland North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest North Pacific Hypermaritime Sitka Spruce Forest North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest North Pacific Lowland Mixed Hardwood-Conifer Forest and Woodland North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest North Pacific Maritime Mesic Subalpine Parkland North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest North Pacific Mesic Western Hemlock-Silver Fir Forest North Pacific Mountain Hemlock Forest North Pacific Oak Woodland North Pacific Wooded Volcanic Flowage Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest Northern Rocky Mountain Mesic Montane Mixed Conifer Forest *Northern Rocky Mountain Ponderosa Pine Woodland and Savanna Northern Rocky Mountain Subalpine Woodland and Parkland

VEGETATION FORMATION	TERRESTRIAL ECOLOGICAL SYSTEM
	<p>Northern Rocky Mountain Western Larch Savanna</p> <p>* Rocky Mountain Aspen Forest and Woodland</p> <p>Rocky Mountain Lodgepole Pine Forest</p> <p>Rocky Mountain Poor-Site Lodgepole Pine Forest</p> <p>Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland</p> <p>Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland</p>

Figure 4-2: Distribution of Vegetation Formations



Marine Ecological Systems

Marine systems are divided into nine separate geographic regions. Two regions comprise the Pacific Ocean marine systems, and are separated for this planning effort at Point Grenville. Puget Sound and the Strait of Juan de Fuca are divided into seven regions; the Strait of Juan De Fuca, San Juan Islands and Georgia Basin, North Central Puget Sound, South Central Puget Sound, Hood Canal, Whidbey Island, and South Puget Sound.

Marine ecological systems include the following:

Table 4- 2: Marine Ecological Systems

MARINE ECOLOGICAL SYSTEM	DESCRIPTION
Temperate Pacific Tidal Salt and Brackish Marsh	The Tidal Salt and Brackish Marsh Ecological System includes emergent vegetation occurring in tidally influenced wetlands associated with estuaries, lagoons and bays, and behind sand spits.
Temperate Pacific Intertidal Mudflat	Intertidal mudflats are sparsely vegetated areas within intertidal zones.
North Pacific Maritime Eelgrass Bed	Eelgrass beds are submerged vegetated systems found along all coastal areas, but especially abundant in the northern portion of Puget Sound between Everett and British Columbia. They are dominated by the eelgrass <i>Zostera marina</i> .
Estuarine	Estuarine ecological system is the portion of the estuary with constant water.
Nearshore	Nearshore is aquatic ecosystem from shoreline to 100 feet (30 meters) deep and may include marine algae communities, such as kelp beds.
Offshore	Offshore is aquatic ecosystem from 100 feet (30 meters) deep seaward to continental shelf break and may include marine algae communities, such as kelp beds.
Oceanic	Oceanic is the Pacific Ocean aquatic ecosystem seaward of the continental shelf break and may include floating marine algae communities, such as <i>Sargassum</i> seaweeds.

Table 4-3: Summary of Vegetation Formations

Vegetation Formation (17 total)	Distribution (mi ²)	# SGCN closely associated	# SGCN generally associated	Ecosystems of concern (30 total)	ECOREGIONS								
					Northwest Coast	West Cascades	Puget Trough	North Cascades	Columbia	Okanogan	East Cascades	Canadian	Blue Mountains
Alpine Scrub and Grassland	251	2	11	0	x	x		x	x	x	x		x
Barren	336	9	19	0	x	x	x	x		x	x		
Bog & Fen	19	7	11	1	x	x	x	x		x	x	x	
Cliff, Scree & Rock Vegetation	318	14	21	1	x	x	x	x	x	x	x	x	x
Developed & Urban	2040	6	57	0	x	x	x	x	x	x	x	x	x
Flooded & Swamp Forest	1479	49	54	4	x	x	x	x	x	x	x	x	x
Freshwater Aquatic Vegetation, Wet Meadow & Marsh	559	40	68	5	x	x	x	x	x	x	x	x	x
Grassland, Meadow & Shrubland	3707	31	20	3	x	x	x	x	x	x		x	x
Herbaceous Agricultural Vegetation	21,491	11	52	0	x	x	x	x	x	x	x	x	x
Introduced and Semi-Natural	1746	2	38	0			x		x	x	x	x	x
Open Water (freshwater)	4400	67	22	0	x	x	x	x	x	x	x	x	x
Recently Disturbed or Modified	6648	5	63	0	x	x	x	x	x	x	x	x	x
Salt Marsh Vegetation	224	3	25	3	x		x		x	x	x		x
Scrub & Herbaceous Coastal Vegetation	28	12	4	1	x	x	x						
Semi-Desert Scrub & Grassland	199	22	44	4		x	x	x	x	x	x	x	x
Temperate Forest	28,818	66	55	8	x	x	x	x	x	x	x	x	x

Table 3: Summary of Vegetation Formations

Figure 4-3: Formations and SGCN Association

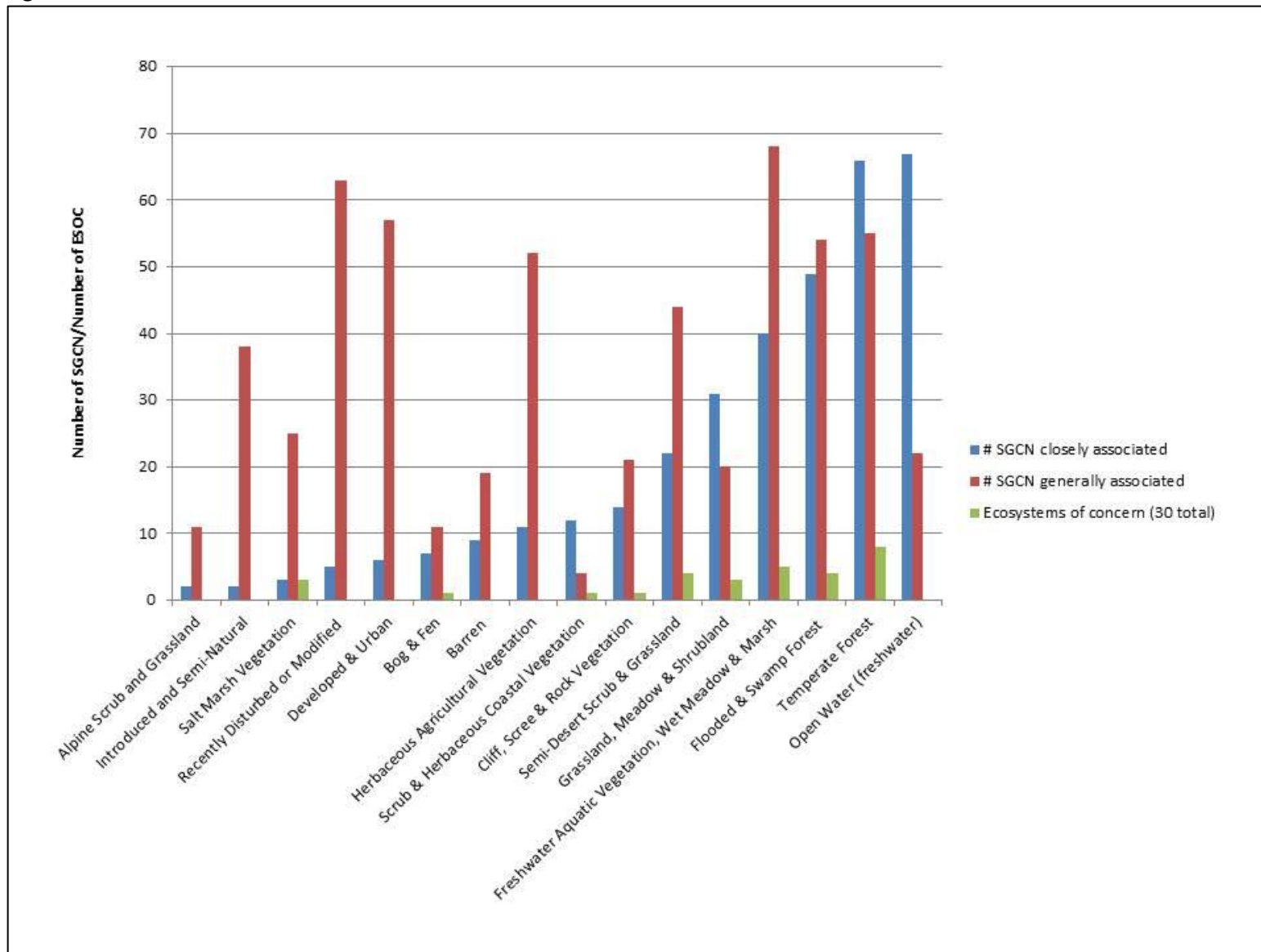


Table 4-4: Ecoregions, Formations, and Ecological Systems of Concern

ECOLOGICAL SYSTEMS OF CONCERN BY VEGETATION FORMATION AND ECOREGION	ECOREGIONS								
	Northwest Coast	West Cascades	Puget Trough	North Cascades	Columbia Plateau	Okanagan	East Cascades	Canadian Rocky Mountains	Blue Mountains
BOG AND FEN									
North Pacific Bog & Fen	X	X	X	X			X		
CLIFF, SCREE, AND ROCK VEGETATION									
Inter-mountain Basins Active & Stabilized Dune					X	X	X		
FLOODED SWAMP AND FOREST									
Columbia Basin Foothill Riparian Woodland & Shrubland					X	X	X	X	X
North Pacific Hardwood-Conifer Swamp	X	X	X	X			X		
North Pacific Lowland Riparian Forest & Shrubland	X	X	X	X	X	X	X		
Northern Rocky Mountain Lower Montane Riparian Woodland & Shrubland					X	X	X	X	X
FRESHWATER AQUATIC VEGETATION, WET MEADOW, AND MARSH									
North American Arid West Emergent Marsh					X	X	X	X	X
North Pacific Intertidal Freshwater Wetland	X	X	X						
Temperate Pacific Freshwater Emergent Marsh	X	X	X	X		X	X		
Temperate Pacific Freshwater Mudflat	X	X	X				X		
Willamette Valley Wet Prairie			X						
GRASSLAND, MEADOW, AND SHRUBLAND									
Columbia Basin Foothill and Canyon Dry Grassland					X	X	X	X	X
Columbia Basin Palouse Prairie					X	X	X	X	X
Willamette Valley Upland Prairie and Savanna	X	X	X						
SALT MARSH VEGETATION									
Inter-mountain Basins Greasewood Flat					X	X	X		X
Inter-mountain Basins Playa and Alkaline Closed Depression					X	X	X		X

ECOLOGICAL SYSTEMS OF CONCERN BY VEGETATION FORMATION AND ECOREGION	ECOREGIONS								
	Northwest Coast	West Cascades	Puget Trough	North Cascades	Columbia Plateau	Okanagan	East Cascades	Canadian Rocky Mountains	Blue Mountains
Temperate Pacific Tidal Salt and Brackish Marsh	X		X						
SCRUB AND HERBACEOUS COASTAL VEGETATION									
North Pacific Maritime Coastal Sand Dune and Strand	X	X	X						
SEMI-DESERT SCRUB AND GRASSLAND									
Columbia Plateau Low Sagebrush Steppe					X	X	X		X
Columbia Plateau Steppe and Grassland					X	X	X	X	X
Inter-mountain Basins Big Sagebrush Steppe			X	X	X	X	X	X	X
Inter-mountain Basins Semi-desert Shrub Steppe					X	X	X		X
TEMPERATE FOREST									
East Cascades Oak-ponderosa Pine Forest and Woodland		X			X	X	X		
North Pacific Dry Douglas-fir-(Madrone)Forest and Woodland	X	X	X	X					
North Pacific Hypermaritime Sitka Spruce Forest	X		X						
North Pacific Hypermaritime Western Red-cedar Western Hemlock Forest	X		X						
Northern Rocky Mountain Ponderosa Pine Woodland and Savanna		X		X	X	X	X	X	X
Northern Rocky Mountain Western Larch Savanna					X	X	X	X	X
North Pacific Oak Woodland	X	X	X		X	X	X		
Rocky Mountain Aspen Forest and Woodland				X	X	X	X	X	X

Table 4-5: Key Stressors and Conservation Actions

VEGETATION FORMATION	ECOLOGICAL SYSTEMS OF CONCERN	STRESSORS											ACTIONS											
		Energy Development	Roads & Development	Alteration of Hydrology	Altered Fire Regime	Dams and Diversions	Agricultural side effects	Climate Change	Overharvesting	Invasive Species	Habitat Loss /degradation	Recreation Impacts	Need for Outreach/Ed	Habitat Conservation	Partner/Stakeholder Eng.	Water Management	Fire Management	Invasive Species Control	Create New Habitat	Grazing/Farm Mgmt	Water rights	Research or Surveys	Restoration	Land Use Planning
Alpine Scrub, Forb Meadow & Grassland Vegetation							X			X	X					X	X							
Barren							X						X										X	
Bog & Fen	North Pacific Bog & Fen		X	X			X	X					X											
Cliff, Scree and Rock Vegetation	Inter-Mountain Basins Active and Stabilized Dune						X				X												X	
Developed and Urban			X		X					X		X		X		X							X	
Flooded & Swamp Forest	Columbia Basin Foothill Riparian Woodland & Shrubland					X	X	X	X	X					X	X		X		X	X	X		
Flooded & Swamp Forest	North Pacific Hardwood Conifer Swamp								X	X							X						X	
Flooded & Swamp Forest	North Pacific Lowland Riparian Forest & Shrubland		X			X	X	X						X	X					X	X		X	
Flooded & Swamp Forest	Northern Rocky Mountain Lower Montane Riparian Woodland & Shrubland						X	X	X								X		X					

VEGETATION FORMATION	ECOLOGICAL SYSTEMS OF CONCERN	STRESSORS												ACTIONS											
		Energy Development	Roads & Development	Alteration of Hydrology	Altered Fire Regime	Dams and Diversions	Agricultural side effects	Climate Change	Overharvesting	Invasive Species	Habitat Loss /degradation	Recreation Impacts	Need for Outreach/Ed	Habitat Conservation	Partner/Stakeholder Eng.	Water Management	Fire Management	Invasive Species Control	Create New Habitat	Grazing/Farm Mgmt	Water rights	Research or Surveys	Restoration	Land Use Planning	Private Lands Incentives
Freshwater Aquatic Vegetation, Wet Meadow & Marsh	North American Arid West Emergent Marsh						X	X		X	X					X		X		X	X				X
Freshwater Aquatic Vegetation, Wet Meadow & Marsh	North Pacific Intertidal Freshwater wetland			X				X		X	X							X	X				X		
Freshwater Aquatic Vegetation, Wet Meadow & Marsh	Temperate Pacific Freshwater Emergent Marsh		X							X								X						X	
Freshwater Aquatic Vegetation, Wet Meadow & Marsh	Temperate Pacific Freshwater Mudflat	X		X						X	X					X		X	X				X		
Freshwater Aquatic Vegetation, Wet Meadow & Marsh	Willamette Valley Wet Prairie										X			X							X				X
Grassland, Meadow & Shrubland	Columbia Basin Foothill & Canyon Dry Grassland				X		X			X	X						X	X		X			X		X
Grassland, Meadow & Shrubland	Columbia Basin Palouse Prairie				X					X	X						X	X					X		
Grassland, Meadow & Shrubland	Willamette Valley Upland Prairie & Savanna		X		X					X	X			X	X		X	X					X		X
Herbaceous Agricultural Vegetation				X			X									X				X					
Introduced and Semi-natural							X													X			X		

VEGETATION FORMATION	ECOLOGICAL SYSTEMS OF CONCERN	STRESSORS												ACTIONS											
		Energy Development	Roads & Development	Alteration of Hydrology	Altered Fire Regime	Dams and Diversions	Agricultural side effects	Climate Change	Overharvesting	Invasive Species	Habitat Loss /degradation	Recreation Impacts	Need for Outreach/Ed	Habitat Conservation	Partner/Stakeholder Eng.	Water Management	Fire Management	Invasive Species Control	Create New Habitat	Grazing/Farm Mgmt	Water rights	Research or Surveys	Restoration	Land Use Planning	Private Lands Incentives
Open Water			X	X			X	X						X						X		X	X	X	
Recently Disturbed or Modified										X	X			X			X	X					X		
Salt Marsh Vegetation	Inter-mountain Basins Greasewood Flat		X	X			X			X	X			X				X		X					
Salt Marsh Vegetation	Inter-mountain Basins Playa & Alkaline Closed Depression		X	X			X			X	X			X				X		X			X		
Salt Marsh Vegetation	Temperate Pacific Tidal Salt & Brackish Marsh		X							X	X							X					X		
Scrub & Herbaceous Coastal Vegetation	North Pacific Maritime Coastal Sand Dune & Strand		X							X	X	X		X				X					X	X	
Semi-desert Scrub & Grassland	Columbia Plateau Low Sagebrush Steppe						X			X	X							X		X					
Semi-desert Scrub & Grassland	Columbia Plateau Steppe & Grassland	X	X		X		X			X	X			X			X	X		X			X		X
Semi-desert Scrub & Grassland	Inter-mountain Basins Big Sagebrush Steppe	X	X		X		X	X		X	X			X			X	X		X			X		X
Semi-desert Scrub & Grassland	Inter-mountain Basins Semi-desert Shrub Steppe		X		X		X	X		X	X			X			X	X		X			X		X
Temperate Forest	East Cascades Oak-Ponderosa Pine Forest & Woodland		X		X			X		X	X			X			X	X					X		X

VEGETATION FORMATION	ECOLOGICAL SYSTEMS OF CONCERN	STRESSORS											ACTIONS												
		Energy Development	Roads & Development	Alteration of Hydrology	Altered Fire Regime	Dams and Diversions	Agricultural side effects	Climate Change	Overharvesting	Invasive Species	Habitat Loss /degradation	Recreation Impacts	Need for Outreach/Ed	Habitat Conservation	Partner/Stakeholder Eng.	Water Management	Fire Management	Invasive Species Control	Create New Habitat	Grazing/Farm Mgmt	Water rights	Research or Surveys	Restoration	Land Use Planning	Private Lands Incentives
Temperate Forest	North Pacific Dry Douglas-fir (Madrone) Forest & Woodland		x		x				x	x	x			x			x	x					x		x
Temperate Forest	North Pacific Hypermaritime Sitka Spruce Forest		x		x				x	x	x			x			x	x					x		x
Temperate Forest	North Pacific Hypermaritime Western Red-cedar- Western Hemlock Forest		x					x	x	x	x			x				x					x		x
Temperate Forest	North Pacific Oak Woodland		x		x					x	x			x			x	x					x		x
Temperate Forest	Northern Rocky Mountain Ponderosa Pine Woodland & Savanna				x			x		x	x			x			x	x					x		x
Temperate Forest	Northern Rocky Mountain Western Larch Savanna		x		x			X		x	x			x			x	x					x		x
Temperate Forest	Rocky Mountain Aspen Forest & Woodland		x		x			x		x	x			x			x	x					x		x

4.3 DESCRIPTIONS OF VEGETATION FORMATIONS AND ECOLOGICAL SYSTEMS OF CONCERN

MARINE ECOLOGICAL SYSTEMS

Overview

Marine systems are divided into nine separate geographic regions. Two regions comprise the Pacific Ocean marine systems, and are separated for this planning effort at Point Grenville. Puget Sound and the Strait of Juan de Fuca are divided into seven regions: Strait of Juan de Fuca, San Juan Islands, North Central Puget Sound, South Central Puget Sound, Hood Canal, Whidbey Island Basin, and South Puget Sound.

Marine ecological systems are described in Table 2 and include seven systems: Temperate Pacific Tidal Salt and Brackish Marsh, Temperate Pacific Intertidal Mudflat, North Pacific Maritime Eelgrass Bed, Estuarine, Nearshore, Offshore, and Oceanic.

Overall Distribution	# of SGCN with close association	# of SGCN with general association
Washington Coast and Puget Sound	25	61

Ecological System	SGCN with close*and general association
TEMPERATE PACIFIC TIDAL AND BRACKISH MARSH	<p>MAMMALS: Sea Otter</p> <p>BIRDS: Bald Eagle, Brown Pelican, Dusky Canada Goose*, Peregrine Falcon, Western High Arctic Brant</p> <p>FISH: Eulachon-southern DPS, Pacific Lamprey, Puget Sound Chinook Salmon ESU, Lower Columbia River Chinook Salmon ESU, Lower Columbia Coho ESU, Hood Canal Summer Chum Salmon ESU, Columbia River Chum salmon ESU, Puget Sound Steelhead DPS, Lower Columbia Steelhead DPS, Middle Columbia Steelhead DPS, Upper Columbia Steelhead DPS, Snake River Basin Steelhead DPS, Bull Trout-Coastal Recovery Unit</p> <p>INVERTEBRATES: Island Marble*</p>
NORTH PACIFIC MARITIME EELGRASS BED	<p>MAMMALS: Sea Otter</p> <p>BIRDS: Bald Eagle, Brown Pelican, Dusky Canada Goose*, Common Loon, Marbled Godwit*, Peregrine Falcon, Red Knot*, Surf Scoter, Western High Arctic Brant*</p> <p>FISH: Broadnose Sevengill Shark, Bocaccio-Puget Sound/Georgia Basin DPS, Brown Rockfish, Copper Rockfish, Quillback Rockfish, Pacific Cod-Salish Sea population, Pacific Herring-Georgia Basin DPS*, Pacific Sand Lance, Surf Smelt, Walleye Pollock-South Puget Sound, Pacific Lamprey, River Lamprey, Green Sturgeon-southern DPS, White Sturgeon-Columbia River, Puget Sound Chinook Salmon ESU, Lower Columbia River Chinook Salmon ESU, Upper Columbia River Spring Chinook Salmon ESU, Snake River Spring/summer Chinook Salmon ESU, Snake River Fall Chinook Salmon ESU, Lower Columbia Coho ESU, Hood Canal Summer Chum Salmon ESU, Columbia River Chum Salmon ESU, Puget Sound Steelhead DPS, Lower Columbia Steelhead DPS, Middle Columbia Steelhead DPS, Upper Columbia Steelhead DPS,</p>

Ecological System	SGCN with close*and general association
	Snake River Basin Steelhead DPS, Bull Trout-Coastal Recovery Unit
TEMPERATE PACIFIC INTERTIDAL MUDFLAT	<p>BIRDS: Bald Eagle, Brown Pelican, Dusky Canada Goose*, Marbled Godwit*, Peregrine Falcon, Red Knot*, Surf Scoter, Western High Arctic Brant</p> <p>FISH: Green Sturgeon-southern DPS, White Sturgeon-Columbia River, Puget Sound Chinook Salmon ESU, Hood Canal Summer Chum Salmon ESU, Columbia River Chum Salmon ESU</p>
ESTUARINE	<p>MAMMALS: Killer Whale, Sea Otter</p> <p>BIRDS: Bald Eagle, Brown Pelican, Common Loon, Dusky Canada Goose*, Harlequin Duck, Marbled Murrelet, Peregrine Falcon, Red-necked Grebe, Surf Scoter*, Western Grebe, Western High Arctic Brant*, White-winged Scoter*</p> <p>FISH: Bluntnose Sixgill Shark, Broadnose Sevengill Shark*, Pacific Herring-Georgia Basin DPS, Pacific Sand Lance, Surf Smelt, Eulachon-southern DPS, Pacific Lamprey, River Lamprey, Green Sturgeon-southern DPS, White sturgeon-Columbia River*, Puget Sound Chinook Salmon ESU, Lower Columbia River Chinook Salmon ESU*, Upper Columbia River Spring Chinook Salmon ESU, Snake River Spring/summer Chinook Salmon ESU, Snake River Fall Chinook Salmon ESU, Lower Columbia Coho ESU, Hood Canal Summer Chum Salmon ESU*, Columbia River Chum Salmon ESU*, Puget Sound Steelhead DPS, Lower Columbia Steelhead DPS, Middle Columbia Steelhead DPS, Upper Columbia Steelhead DPS, Snake River Basin Steelhead DPS, Bull Trout-Coastal Recovery Unit</p>
NEARSHORE	<p>MAMMALS: Gray Whale, Harbor Porpoise, Humpback Whale, Killer Whale, Sea Otter</p> <p>BIRDS: Bald Eagle, Barrow's Goldeneye, Brown Pelican, Clark's Grebe, Common Loon*, Dusky Canada Goose*, Harlequin Duck, Marbled Murrelet*, Peregrine Falcon, Red-necked Grebe*, Surf Scoter*, Tufted Puffin, Western Grebe*, Western High Arctic Brant, White-winged Scoter*</p> <p>FISH: Bluntnose Sixgill Shark, Broadnose Sevengill Shark*, Bocaccio-Puget Sound/Georgia Basin DPS, Brown Rockfish, Canary Rockfish-Puget Sound/Georgia Basin DPS, Copper Rockfish*, Greenstriped Rockfish, Redstripe Rockfish, Tiger Rockfish, Quillback Rockfish, Yelloweye Rockfish-Puget Sound/Georgia Basin DPS, Pacific Cod-Salish Sea Population, Pacific Hake-Georgia Basin DPS, Pacific Herring-Georgia Basin DPS*, Pacific Sand Lance*, Surf Smelt*, Walleye Pollock-South Puget Sound, Eulachon-Southern DPS, Pacific Lamprey, River Lamprey, Green Sturgeon-Southern DPS, White Sturgeon-Columbia River*, Puget Sound Chinook Salmon ESU, Lower Columbia River Chinook Salmon ESU, Upper Columbia River Spring Chinook Salmon ESU, Snake River Spring/summer Chinook Salmon ESU, Snake River Fall Chinook Salmon ESU, Lower Columbia Coho ESU, Hood Canal Summer Chum Salmon ESU*, Columbia River Chum Salmon ESU, Puget Sound Steelhead DPS, Lower Columbia Steelhead DPS, Middle Columbia Steelhead DPS, Upper Columbia Steelhead DPS, Snake River Basin Steelhead DPS, Ozette Sockeye ESU, Bull Trout-Coastal Recovery Unit</p>

Ecological System	SGCN with close*and general association
OFFSHORE	<p>MAMMALS: Gray Whale, Harbor Porpoise, Humpback Whale, Killer Whale, Minke Whale, Sea Otter,</p> <p>BIRDS: Clark’s Grebe, Common Loon*, Dusky Canada Goose*, Marbled Murrelet*, Peregrine Falcon, Red-necked Grebe*, Surf Scoter*, Tufted Puffin, Short-tailed Albatross, Western Grebe*, Western High Arctic Brant, White-winged Scoter*</p> <p>FISH: Bluntnose Sixgill Shark, Broadnose Sevengill Shark, Bocaccio-Puget Sound/Georgia Basin DPS, Brown Rockfish, Canary Rockfish-Puget Sound/Georgia Basin DPS, Copper Rockfish, Greenstriped Rockfish, Redstripe Rockfish, Tiger Rockfish, Quillback Rockfish, Yelloweye Rockfish-Puget Sound/Georgia Basin DPS, Pacific Cod-Salish Sea Population, Pacific Hake-Georgia Basin DPS, Pacific Herring-Georgia Basin DPS, Pacific Sand Lance, Surf Smelt, Walleye Pollock-South Puget Sound, Eulachon-southern DPS, Pacific Lamprey, Green Sturgeon-southern DPS, White Sturgeon-Columbia River, Puget Sound Chinook Salmon ESU, Lower Columbia River Chinook Salmon ESU, Upper Columbia River Spring Chinook Salmon ESU, Snake River Spring/summer Chinook Salmon ESU, Snake River Fall Chinook Salmon ESU, Lower Columbia Coho ESU, Hood Canal Summer Chum Salmon ESU, Columbia River Chum salmon ESU, Puget Sound Steelhead DPS, Lower Columbia Steelhead DPS, Middle Columbia Steelhead DPS, Upper Columbia Steelhead DPS, Snake River Basin Steelhead DPS, Ozette Sockeye ESU, Bull Trout-Coastal Recovery Unit</p>
OCEANIC	<p>MAMMALS: North Pacific Right Whale*, Blue Whale*, Fin Whale*, Gray Whale, Harbor Porpoise, Humpback Whale, Killer Whale, Minke Whale, Sei Whale*, Sperm Whale*</p> <p>BIRDS: Short-tailed Albatross*, Tufted Puffin</p> <p>FISH: Bluntnose Sixgill Shark*, Puget Sound Chinook Salmon ESU, Lower Columbia River Chinook Salmon ESU, Upper Columbia River Spring Chinook Salmon ESU, Snake River Spring/summer Chinook Salmon ESU, Snake River Fall Chinook Salmon ESU, Lower Columbia Coho ESU, Hood Canal Summer Chum Salmon ESU, Puget Sound Steelhead DPS, Lower Columbia Steelhead DPS, Middle Columbia Steelhead DPS, Upper Columbia Steelhead DPS, Snake River Basin Steelhead DPS</p>

*SGCN is closely associated with this system

Major Stressors

Invasive species (e.g., saltmarsh cordgrass (*Spartina alterniflora*), Green Crab), coastal development, overharvesting (fish and shellfish species), degraded water quality and climate change are all stressors which threaten the habitat values provided by these systems.

Degraded water quality resulting from land use practices have altered significant portions of the shallow marine systems and continue to alter remaining areas. The physical and chemical conditions of these habitats are degraded by the discharge of municipal, industrial, and agricultural effluents. Invasions of exotic plants and animals pose significant, long-term ecological and economic threats to this habitat.

Sea level rise is the most significant climate change stressor for the salt and brackish marshes, leading to submergence of tidal salt marshes and declines in vegetation unless they are able to migrate inwards

through sediment accretion. Nearshore and estuarine systems will also be affected by sea level rise, as well as impacts from increased wave height and intensity and increasing water temperatures. Oceanic systems are at risk from changing ocean chemistry and rising levels of acidification, which has already been affecting the viability of oysters and other shellfish in Puget Sound.

Habitat needs for SGCN associated with marine systems

Fish/invertebrate spawning grounds	Many of these systems provide essential spawning habitat for forage fish and other species.
High invertebrate diversity/abundance	Invertebrates in mudflats are food for many of these species like Harlequin Duck and Marbled Godwit.
High water quality	Water must lack high levels of pollutants and have appropriate physiochemical attributes (temperature, salinity, etc.).

Actions needed to maintain habitat quality for SGCN

- Invasive species control.
- Improvements to water quality, discharge from human development (variety of sources)
- Minimize risks from oil spills.
- Develop appropriate land use planning that adequately protects spawning beaches for sand lance and surf smelt.

Research and Data Needs

- Areas used by life history stages and movements of juveniles before selection of adult habitat is poorly understood for many of our SGCN marine fishes, especially rockfish.
- Population, life history, and distribution information is needed for both shark species.
- Track and monitor evidence and effects of changing sea levels.

ALPINE SCRUB, FORB MEADOW AND GRASSLAND VEGETATION

Overview

Alpine scrub, forb meadow and grassland vegetation formation includes two closely related ecological systems, Rocky Mountain Alpine Dwarf Shrubland, Fell-Field and Turf, and North Pacific Dry and Mesic Alpine Dwarf-shrubland, Fell-field and Meadow. These are vegetated areas found above the environmental limit of trees, at the highest elevations of the Olympic and Cascade Mountains. Cold, windblown areas supporting a mosaic of dwarf-shrublands, fell fields, tundra (sedge tufts), and sparsely vegetated snowbed communities. Small patches of krummholz (shrub-form trees) are also part of this system and occur at the lower elevations. These systems differ primarily in geographic distribution and resulting difference in associated flora.

Sites are slopes and depressions where snow lingers, where the soil has become relatively stabilized, and where the water supply is more or less constant. Dwarf shrublands are often found on level or concave glacial topography, with late-lying snow and sub irrigation from surrounding slopes. Fell fields are found in wind-scoured areas such as ridgetops and exposed saddles. Species with close association within these ecological systems include White-tailed Ptarmigan and Olympic Marmot. Species with general association include Golden Eagle, American Pika, Cascade Red Fox, Grizzly Bear, Northern Bog Lemming, Wolverine, Cascades Needlefly and Northern Forestfly. This formation contains no ecological systems of concern.

Distribution	Public Land	Private Land	SGCN with close association (#)	SGCN with general association (#)	Ecological systems of concern (#)
156 mi ²	>99%	<1%	2	11	0

Major stressors

Climate change, which may result in reduced snowpack and encroachment by trees and shrubs, is a major stressor. Trampling and associated recreational impacts are a major source of human disturbance. In recent years, Olympic marmots have disappeared from some of the driest meadows in the northeast Olympic Mountains.

Habitat needs for SGCN associated with this system.

Prevent encroachment of trees and large shrubs	Trees and large shrubs are encroaching on habitat on the Olympic Peninsula and the Cascades, providing a potential threat to species like the Olympic Marmot and White-tailed Ptarmigan, both closely associated with these systems.
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Actions needed to maintain habitat quality for SGCN

- Fire management (establishment of natural fire regimes and prescribed fire).
- Control of invading species, primarily native trees and shrubs.

Key research and data needs

- Conducting prescribed fire to enhance habitat and minimize public concerns.

Specific Ecological System References (complete list at end of chapter)

Edelman, A. J. 2003. *Marmota olympus*. Mammalian Species 736: 1-5.

Schroeder, M. A. 2005. White-tailed ptarmigan. Page 68 in T. R. Wahl, B. Tweit, and S. G. Mlodinow, editors. Birds of Washington. Oregon State University Press, Corvallis, Oregon.

BARREN

Overview

Barren vegetation formation includes two ecological systems, Alpine Ice Field and Unconsolidated Shore. Unconsolidated shore is material such as silt, sand, or gravel that is subject to inundation and, most importantly, redistribution due to the action of water in high energy environments (e.g. beaches, rivers). It is characterized by substrates lacking vegetation except for pioneering plants that become established during brief periods when growing conditions are favorable. Erosion and deposition by waves, currents, and seasonal flooding produce a number of landforms representing this class; the most common examples include sand and rock beaches along the outer coast and braided gravel beds associated with rivers and streams. Alpine ice field includes glaciers and perennial snow and ice features.

Nine Species of Greatest Conservation Need have a close association to these systems: American White Pelican, Brown Pelican, Snowy Plover, Streaked Horned Lark, Rock Sandpiper, Dusky Canada Goose, Peregrine Falcon, Harlequin Duck and Puget Sound Chinook Salmon ESU. The bird species are associated with the unconsolidated shore system only. A complete analysis of habitat association has not been done for all SGCN anadromous and freshwater fishes, thus it is possible that other SGCN fishes may be closely associated with this system. This formation contains no ecological systems of concern.

Distribution	Public Land	Private Land	SGCN with close association (#)	SGCN with general association (#)	Ecological systems of concern (#)
209 mi ²	84%	1%	9	13	0

Major stressors

Climate change is a significant stressor for the Alpine Ice Field Ecological System (decline of glaciers and reduction in snowpack) and unconsolidated shore in coastal areas (rise of sea level, shoreline armoring limits the flow of sediment in unconsolidated shorelines).

Habitat needs for SGCN associated with unconsolidated shore

Unvegetated condition	Species use in these systems results from an absence of vegetation and re-setting of succession cause by disturbance and perhaps to some extent to its proximity to open water. This system is used for nesting (e.g. Snowy Plover), roosting (e.g. Brown Pelican) and foraging (e.g. Rock Sandpiper).
High invertebrate abundance/diversity	Invertebrates are important food for Harlequin Duck and Rock Sandpiper, among others.
Floodplain gravel beds	Gravels beds within river floodplains are important for maintaining spawning habitat for salmonids and contributing to instream habitat for other fishes.

Actions needed to maintain habitat quality for SGCN

Use of alternative techniques to shoreline and river armoring can protect both development and fresh and salt water shorelines. Restoration of floodplains, such as by dike removal or set-back, can allow gravel beds to develop and increase. There are few threats to these systems beyond the threat of climate change. Oil spills could significantly impact wildlife using unconsolidated shore.

BOG AND FEN

Overview

Bog and fen vegetation formation includes two ecological systems in Washington, North Pacific Bog and Fen, and Rocky Mountain Subalpine –Montane Fen. Most bogs and fens are less than 12 acres in size. The North Pacific Bog and Fen ecological system is composed of peatlands that occur as small patches along the Pacific coast from southeastern Alaska to northern California, in and west of the coastal mountain summits including the Puget Sound lowlands. The Rocky Mountain Subalpine-Montane Fen Ecological System includes high elevation wetlands with organic soils in eastern Washington. It is confined to specific environments where perennial groundwater discharge occurs, such as low points in the landscape or near slopes where groundwater intercepts the soil surface, or along pond/lake shorelines.

Bogs and fens differ from other wetlands in having a substrate composed of organic material, typically in the form of peat and muck. The origin of the peat can be *Sphagnum* moss, 'brown' mosses, sedges, or woody species. Within the North Pacific Bog and Fen Ecological System, vegetation is usually a mix of conifer-dominated overstory, shrubs, and open *Sphagnum* or sedge lawns, often with small ponds and pools interspersed. Graminoids, evergreen or deciduous broadleaf shrubs, or evergreen needleleaf trees are commonly dominant. Many plant species are confined to this system.

Distribution	Public Land	Private Land	SGCN with close association (#)	SGCN with general association (#)	Ecological systems of concern (#)
13 mi ²	43%	57%	7	11	1

Habitat needs for SGCN associated with this system.

High ecological integrity	Many of the invertebrates associated with this system are associated with native plants, high ecological integrity, and are sensitive to invasive shrubs and grasses.
Adequate groundwater level	Fish that use ponds and pools of this system, such as Olympic Mudminnow, require adequate ground water levels to maintain the water bodies.

Climate Change

Climate changes such as decreased precipitation, reduced snowpack, or prolonged drought that reduces water availability and recharge may lead to range contraction and/or habitat conversion, increased invasion of dry-adapted species, or tree encroachment in bog and fen habitats. Shifts from snow to rain that

enhances winter/spring flood risk may increase erosion of moist peat and topsoil, reduce opportunities for recharge, and/or lead to drying of habitats.

Actions needed to maintain habitat quality for SGCN

Site protection; sites with high ecological integrity and corresponding SGCN should be identified and protected. Groundwater withdrawals should be regulated to preserve groundwater levels needed to maintain aquatic habitat conditions.

Research and data needs

While some bogs have been surveyed in detail, most have not. The range of rare species, including several beetles and Makah Copper are not thoroughly documented.

Ecological systems discussed in greater detail in this chapter

Of the two ecological systems found in this formation, North Pacific Bog and Fen is discussed in greater detail here. It is considered an ecological system of concern because of its imperiled conservation status and because of its importance to SGCN.

North Pacific Bog and Fen

Description and Distribution

The North Pacific Bog and Fen Ecological System is located primarily in the North Pacific Ecoregion, but is sporadically distributed through the west side and eastern slopes of the Cascades. Elevations are mostly under 1500 feet, and annual precipitation ranges from 35 to 120 inches. However, fens are also found within the Cascades and Olympic Mountains. The system is found in primarily in glaciated terrain but also in river valleys, around lakes and marshes, behind coastal sand dunes, or on slopes. Four Species of Greatest Conservation Need are closely associated with this Ecological system: Olympic Mudminnow, Beller's Ground Beetle, Hatch's Click Beetle, and Makah Copper.

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes Freshwater Wetlands	S2	Imperiled/ declining. Declines of 30-50% in last 50 years and from historical condition.	MAMMALS: Wolverine, Western Spotted Skunk, Townsend's Big-eared Bat, Northern Bog Lemming, Keen's Myotis, Hoary Bat*
			BIRDS: Sandhill Crane
			FISH: Olympia Mudminnow
			INVERTEBRATES: Beller's Ground Beetle*, Hatch's Click Beetle*, and Makah Copper

* SGCN is closely associated with this ecological system

Stressors and Actions Needed

Historical and contemporary land use practices have impacted hydrologic, geomorphic, and biotic structure and function of peatlands in western Washington. Conversion of peatlands for agriculture has resulted in significant loss of peatland extent. These areas are often cultivated for food crops such as blueberries and cranberries.

Reservoirs, water diversions and withdrawals, ditches, roads, and human land uses in the contributing watershed (fens) or surrounding landscape can also have a substantial impact on the hydrological regime. Direct alteration of hydrology (i.e., channeling, draining, damming) or indirect alteration (i.e., roads or removing vegetation on adjacent slopes) results in changes in species composition and wetland extent. Water diversions and ditches can have a substantial impact on the hydrology as well as biological integrity of peatland.

Climate change poses a particular future threat to this system. Bog and fen habitats, particularly those that depend on surface water, are sensitive to drier climate conditions that can lead to habitat conversion or range contraction, increased invasion of dry-adapted species.

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Agriculture and aquaculture side effects	Conversion to agriculture eliminates and degrades habitat	<ul style="list-style-type: none"> • Grazing/farm management • Land acquisition • Land use planning • Private lands agreements 	Protect key sites through acquisition, easement, planning, and protection of hydrology
Roads and development	Development near bogs and fens degrades habitat	<ul style="list-style-type: none"> • Land acquisition • Land use planning • Environmental review • Private lands agreements 	Protect key sites through acquisition, easement, planning and protection of hydrology
Alteration of hydrology	Alteration of hydrology degrades habitat	<ul style="list-style-type: none"> • Water management 	Maintain or re-configure hydrological sources and routes
Climate change	Drier conditions may lead to habitat conversion or range contraction	<ul style="list-style-type: none"> • Address existing stressors 	Build resilience for added stress of climate change by addressing existing stressors

CLIFF, SCREE AND ROCK VEGETATION

Overview

Cliff, scree, and rock vegetation include eight systems that generally have little or no vegetation or soil development. These systems include steep cliff faces, narrow canyons, and larger rock outcrops of various igneous, sedimentary, and metamorphic bedrock types. Some systems are characterized by the presence of unstable scree and talus that typically occur below cliff faces as well as sand dunes. Small patches of dense vegetation, typically scattered trees or shrubs, can occupy rock fractures and less steep or more stable slopes. . Although herbaceous cover tends to be limited in these systems mosses or lichens may be very dense and well-developed, displaying well over 10 percent cover.

Distribution	Public Land	Private Land	SGCN with close association (#)	SGCN with general association (#)	Ecological systems of concern (#)
610 mi ²	91%	9%	14	22	1

Major Stressors

- Much of this system occurs in designated wilderness areas and is not exposed to serious threats. This system is generally inaccessible which precludes most human activities.
- Global climate change could alter species composition of this system possibly by allowing more vascular plant species to establish as well as a shift in species composition.
- Invasive plants is mainly a threat within the Inter-Mountain Basins Active and Stabilized Dune Ecological System. This is generally not much of a threat to the other ecological systems associated with Cliff, Scree, and Rock vegetation.

Habitat needs for SGCN associated with this system

Nesting habitat	Golden Eagle and Peregrine Falcon nest on cliffs and rock faces.
Habitat complexity	Voids and fissures in rock and talus provide roosting habitat for Townsend's Big-eared Bats and denning habitat for American Pika, Wolverine, and Olympic Marmot.

Actions needed to maintain habitat quality for SGCN

- Activities that disturb or displace species that use the system should be discouraged or not allowed during sensitive times. Those activities may include mining or recreation such as rock climbing.
- Activities that remove habitat such as substrate mining should be discouraged.

Ecological systems discussed in greater detail in this chapter include:

- A. Inter-Mountain Basins Active and Stabilized Dune

Inter-Mountain Basins Active and Stabilized Dune

Conservation Status and Concern

Most examples of this system in Washington have either been converted over by various land use activities or have been significantly altered. Seventeen SGCN are associated with Inter-mountain Basins Active and Stabilized Dunes; more than half of which are closely associated with this ecological system. It is an especially important habitat for many of the SGCN amphibian and reptiles of eastern Washington.

Description and Distribution

Although these dunes are primarily restricted to the Columbia Plateau Ecoregion, a few occur in the Okanogan Ecoregion as far north as the boundary with British Columbia in Okanogan County. Sand dunes are highly dynamic systems and patterns of plant species composition are closely related to sand erosion, deposition and dune migration and stabilization (Chadwick and Dalke 1965). These processes may occur rapidly, leaving legacies from previous vegetation types. While repeating patterns of vegetation are observed and allow the identification of community types, they are often present in a spatially complex, fine-scale mosaic. The boundaries between community types range from distinct to highly blurred (Easterly and Salstrom 1997).

Sand dunes support vegetation if wind stress is not too great (WDFW 2008). Although vegetation tends to be variable, dunes often consist of plants common to shrub-steppe, such as antelope bitterbrush, rabbitbrush and snow buckwheat. However, some plants are more restricted to sand dune, such as, Indian Ricegrass, Lemon Scurfpea, and Veiny Dock. The vegetation cover is related to annual rainfall totals and evapotranspiration rates. The mobility of sand dunes is related to the power of the wind, while a dune's mobility becomes inhibited as vegetation cover increases. Long periods of increased precipitation and persistent presence of vegetation may lead to a sand surface covered by litter and/or mosses and lichens. These same factors also can initiate soil formation, which can cause dune stabilization. Periods of drought are generally unfavorable to vegetation and can reinitiate the mobility of sands (WDFW 2008).

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes Inland Dunes	S1	Critically imperiled/ declining. Declines of 50-70% in last 50 years and 70-80% from historical condition.	MAMMALS: Pygmy Rabbit, Spotted Bat
			BIRDS: Burrowing Owl, Ferruginous Hawk*, Short-eared Owl
			REPTILES/AMPHIBIANS: Northern Leopard Frog*, Western Toad, Woodhouse's Toad*, Night Snake, Sagebrush Lizard*, Short-horned Lizard*, Side-blotched Lizard*, Striped Whipsnake*
			FISH: to be determined- research needed
			INVERTEBRATES: A Noctuid Moth*, Columbia River Tiger Beetle*, Morrison's Bumblebee

* SGCN is closely associated with this ecological system

Stressors and Actions Needed

Washington inland sand dune systems have declined approximately 76% from the early 1970s, primarily as a result of conversion to agricultural, reservoir flooding, and dune stabilization (Hallock et al. 2007). Currently, the major threats to Washington's inland sand dunes are invasive species, agricultural

conversion, including the effects of adjacent irrigation, off-road vehicle use, dune stabilization, home development, mining, and livestock grazing (Hallock et al. 2007).

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Invasive and other problematic species	Exotic grasses invading and introduced to actively stabilize dunes are major threat.	<ul style="list-style-type: none"> • Invasive species control • Partner/stakeholder engagement 	Integrated habitat restoration using prescribed fire, weed control, and seeding with native vegetation.
Dams, levees and diversions	The Columbia River Irrigation Project has increased water table creating inter-dunal wetland and ponds that stabilized dunes.	<ul style="list-style-type: none"> • Water management • Water rights acquisition • Partner/stakeholder engagement 	Remove water retention structures and encourage water conservation in agriculture.

Specific Ecological System References (complete list at end of chapter)

Hallock, L. A., R. D. Haugo, and R. Crawford. 2007. Conservation strategy for Washington State inland sand dunes. Natural Heritage Report 2007-05. Prepared for the Bureau of Land Management. Washington Department of Natural Resources. Olympia, Washington.

Washington Department of Fish and Wildlife (WDFW). 2008. Priority Habitat and Species List. Olympia, Washington. 177 pp.

DEVELOPED AND URBAN

Overview

Many think that when lands are developed they lose almost all value as fish and wildlife habitat. Although the habitat needs for most SGCN do not exist in developing and urban landscapes, development never eliminates all fish and wildlife habitat. In fact, even though trends in the number of native species decline along a gradient from rural, to suburban, to the urban core, many native species as well as some SGCN are surprisingly resilient and tolerant of the presence of people. Nesting of Peregrine Falcons on a downtown Seattle skyscraper is an example of how a SGCN can adapt.

Open spaces as well as artificial structures (e.g., bridges, eaves, and feeders) in developed landscapes can also provide suitable nesting, roosting, and foraging opportunities to SGCN and other native species. Although only three terrestrial SGCN, Peregrine Falcon, Streaked Horned Lark, and Sharptail Snake, are closely associated with any of the Developed and Urban Ecological Systems, many others use these systems as habitat in Washington. Many salmonid SGCN must migrate through rivers that run through developed and highly urbanized areas, thus effects on water quality and condition of riparian habitats are of particular concern. Some of their spawning areas are closely associated with developed areas. SGCN salmonids that migrate long distances within the Columbia Basin are exposed to multiple developed areas, resulting in a close association with this habitat form. Problems arise when unplanned development or low-density urban sprawl removes and degrades once-important habitat. With population forecasts showing an additional 2 million Washingtonians by 2040, ensuring wisely planned development will be one of our greatest challenges to conserving fish and wildlife habitat across the state.

Distribution	Public Land	Private Land	SGCN with close association (#)	SGCN with general association (#)	Ecological systems of concern (#)
2,039 mi ²	11%	89%	6	57	0

Major Stressors

- Loss and degradation of habitat and connectivity from low-density urban sprawl.
- Degraded habitat structure from fire suppression in and around rural and exurban home sites.
- Loss of habitat and connectivity in undeveloped areas to provide services (e.g., power-lines).
- Increased human-wildlife conflicts (e.g., Cougar encounters, roadkill deer).
- Harassment and predation by people and domestic animals (e.g., house cats and songbirds).
- Water quality degradation from point and non-point source pollution and water withdrawal.
- Loss and degradation of nearshore and estuarine habitats from industrial and residential development.
- Loss of stream and river habitat and connectivity due to fish passage barriers such as road crossings, culverts, dikes and dams.

Habitat needs for SGCN associated with this system

Habitat connectivity/corridors	A number of SGCN that use Developed and Urban Ecological Systems have limited mobility, inhibiting their movement across barriers such as roads and subdivisions. These low mobility SGCN primarily consist of small rodents, reptiles, and amphibians. SGCN anadromous fishes need passage improvements where various types of instream barriers currently block or impede migrations.
Large unfragmented blocks of habitat	Many SGCN are area sensitive, meaning they have a minimum size threshold for habitat to be functional for uses such as for breeding. Bald Eagle, Peregrine Falcon, Oregon Vesper Sparrow, and Western Gray Squirrel are known to require larger contiguous patches of undeveloped land.
Lower development densities	Most associated SGCN do best where development densities are low (1 home per 10 to 20 acres). However, many of the same species can exist when densities are greater (1 home per 5 acres), so long as development proposals incorporate conservation measures (e.g., cluster development) and do not degrade surface and sub-surface water quality or quantity.
Public education	A better grasp of the needs of SGCN by the public (and especially urban citizens) will help them become better stewards of landscapes and advocates for conservation.
High water quality standards	Most SGCN fishes are likely to be adversely affected by poor water quality. Pollution abatement in water run-off from urban and industrial areas often needs improvement. Sewage treatment systems in low to high intensity developed areas may also be pollution sources. Water withdrawals from rivers and aquifers may reduce flows affecting multiple aspects of water and riverscape habitat quality.

Actions needed to maintain habitat quality for SGCN

- Identify important connectivity areas in developing landscapes to plan future growth.
- Assist local jurisdictions with GMA planning.
- Create database spatial priorities in developing landscapes to protect habitat for SGCN.
- WDFW staff community involvement (e.g., schools and community groups, backyard bird sanctuary enrollments, citizen science projects).
- Management and enforcement of instream flow standards.

Research and Data Needs

- Update management recommendations for specific SGCN which can be used by local governments in their land use ordinances and GMA/SMP updates to protect fish and wildlife and their habitats.
- Develop studies that evaluate the local land use ordinances and how those are effectively protecting SGCN associated habitats.

Specific Ecological System References. (complete list at end of chapter)

Ferguson, H. L., K. Robinette, K. Stenberg. 2001. Wildlife of urban habitats. Pages 317-341 in D. H. Johnson and T. A. O'Neil, Managing Directors. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, Oregon.

Linders, M. J., W. M. Vander Haegen, J. M. Azerrad, R. Dobson, and T. Labbe. 2010. Management Recommendations for Washington's Priority Species: Western Gray Squirrel. Washington Department of Fish and Wildlife, Olympia, Washington.

Washington Department of Fish and Wildlife (WDFW). 2009. Wildlife in a developing landscape. Pages 1-1 to 1-3 in Landscape planning for Washington's wildlife: managing for biodiversity in developing areas. J. Azerrad, J. Carleton, J. Davis, T. Quinn, C. Sato, M. Tihri, S. Tomassi, G. Wilhere, authors. WDFW, Olympia, Washington.

Washington Office of Financial Management. 2014. State of Washington forecast of the state population: November 2014 forecast.

FLOODED AND SWAMP FOREST

Overview

Flooded and swamp forests include 11 riparian and swamp systems comprised primarily of facultative and facultative-wetland vegetation. Although some of these systems are found at higher elevations, most are at low-to mid-elevations and are widely distributed throughout Washington. In eastern Washington, lower to mid-elevation systems are dominated by deciduous trees, while conifers tend to dominate higher elevations. Systems in western Washington have more of a mix of conifer and deciduous trees. The riparian flooded and swamp forest systems hold a special significance to Washington's fauna. Most terrestrial species hold some association with riparian habitat, and all anadromous and freshwater SGCN fish species are closely or generally associated with it. The condition of riparian habitat has large influences on habitat conditions vital for all aquatic organisms (e.g., temperature moderation, instream structure and complexity).

Flooded and swamp forests are generally adapted to high moisture levels, making them vulnerable to projected climate changes in hydrology and fluvial processes resulting from precipitation shifts, reduced snowpack and earlier snowmelt, drought, and altered flow regimes. Declining summer and spring stream flows, particularly when combined with drought, could reduce available water for riparian communities, affecting seedling germination and adult survival and potentially contributing to shifts to more xeric and drought-adapted vegetation. Drought periods may exacerbate fire risk.

Distribution	Public Land	Private Land	SGCN with close association (#)	SGCN with general association (#)	Ecological systems of concern (#)
1479 mi ²	33%	67%	49	54	4

Major Stressors

- Roads
- Water diversions
- Logging
- Invasive plants
- Excessive grazing
- Channelization and diking
- Climate Change

Habitat needs for SGCN associated with this system

Off-channel features	Many closely associated SGCN require or are closely linked with important off-channel habitats such as springs and seeps (Cascade Torrent Salamander and a number of SGCN invertebrates) as well as stream-associated swamps and wetlands (Oregon Spotted Frog and Columbian White-tailed Deer).
High water quality	A number of closely associated SGCN, particularly invertebrates and most SGCN fishes, require waters that are cold, clear, and generally free of silt. These water quality characteristics typically are maintained by functions provided by higher quality riparian habitat.
High ecological integrity	A number of SGCN prefer older and mature riparian forest conditions with high canopy cover and complex structural characteristics. Closely associated SGCN that require these kinds of conditions include Rocky Mountain Tailed Frog, Cascade Torrent Salamander, Dunn's Salamander, and Puget Oregonian. Wood contributed to streams by these riparian forests is extremely important for forming and maintaining instream habitat conditions needed for spawning and rearing by all SGCN anadromous and freshwater salmonids. Riparian wood and plant inputs to streams provide important habitat conditions for SGCN freshwater non-salmonid fishes.

Actions needed to maintain habitat quality for SGCN

- Grazing, agriculture, and farm management (e.g., fencing livestock)
- Forest management (e., g., forest – riparian buffers)
- Riparian habitat integrity protection and maintenance.
- Habitat restoration (e.g., control invasive plants, restore connectivity, floodplain restoration)

Research and Data Needs

- Research to inform riparian conservation planning in arid landscapes.
- Studies on cumulative effects of land use activities within and across watersheds.
- Noticeable gaps in research in the Pacific Northwest need to be filled to address the influences of land uses beyond forestry (e.g., agriculture, urbanization) to help guide riparian management and conservation.

Ecological systems discussed in greater detail in this chapter include:

- A. Columbia Basin Foothill Riparian Woodland and Shrubland
- B. North Pacific Hardwood-Conifer Swamp
- C. North Pacific Lowland Riparian Forest and Shrubland
- D. Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland

Specific Ecological System References. (complete list at end of chapter)

Knutson, K. L., and V. L. Naef. 1997. Management recommendations for Washington's priority habitats: riparian. Washington Department of Fish and Wildlife, Olympia, Washington.

Columbia Basin Foothill Riparian Woodland and Shrubland

Conservation Status and Concern

The Columbia Basin Foothill Riparian Woodland and Shrubland Ecological System has been significantly degraded by historical grazing practices that were poorly managed. This system has also decreased in extent due to agricultural development, roads, dams and other flood-control activities. Twenty-five terrestrial SGCN are associated with this system, of which nine are closely associated species. Although a complete analysis has not been done for all SGCN anadromous and freshwater fishes, several appear closely associated with this system, e.g., Middle Columbia Steelhead DPS, Snake River Basin Steelhead DPS, and Snake River Spring/Summer Chinook Salmon ESU.

Description and Distribution

In the Columbia Plateau Ecoregion, this riparian system occurs along the middle and upper Columbia River and its tributaries. It also is widespread in the lower foothills of the East Cascade, Blue Mountain, and Okanogan Ecoregions. This system is found in low-elevation canyons and draws, on floodplains, in steep-sided canyons, and narrow V-shaped valleys with rocky substrates. Underlying gravels may keep the water table just below the ground surface and are favored substrates for black cottonwood (*Populus balsamifera*). Other trees commonly found in this riparian system are white alder (*Alnus rhombifolia*), quaking aspen (*Populus tremuloides*), water birch (*Betula occidentalis*), and ponderosa pine (*Pinus ponderosa*).

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes Riparian	S2	Imperiled/ declining. Declines of 50-70% in last 50 years and from historical condition.	MAMMALS: Hoary Bat, Silver-haired Bat, Spotted Bat, Townsend's Big-eared Bat
			BIRDS: Bald Eagle, Burrowing Owl, Ferruginous Hawk, Golden Eagle, Lewis' Woodpecker, Loggerhead Shrike, Pygmy Nuthatch
			REPTILES/AMPHIBIANS: Columbia Spotted Frog, Northern Leopard Frog*, Rocky Mountain Tailed Frog*, Western Toad, Ringneck Snake*, Sharptail Snake*
			FISH: to be determined- research needed
			INVERTEBRATES: Columbia Oregonian*, Dry Land Forestsnail, White-belted Ringtail*, Columbia Clubtail*, Mad River Mountainsnail*, Mann's Mollusk-eating Ground Beetle*, Mission Creek Oregonian, Morrison's Bumblebee

* SGCN is closely associated with this ecological system

Stressors and Actions Needed

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Overharvesting of biological resources	Intentional beaver removal has led to loss and degradation of riparian habitat.	<ul style="list-style-type: none"> Native species restoration 	Restore beaver to its historical range

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Climate change and severe weather	Impacting hydrology by altering seasonal inputs of water from rainfall and snowmelt.	<ul style="list-style-type: none"> Research, survey or monitoring – habitat Partner/ stakeholder engagement 	Research to identify climate change effects and to identify most vulnerable riparian areas.
Agriculture and aquaculture side effects	Grazing practices have impacted structure, composition, and function.	<ul style="list-style-type: none"> Grazing/farm management 	Encourage fencing livestock away from sensitive riparian zones.
Dams and diversions	Greatly altering the frequency and intensity of bottomland flooding.	<ul style="list-style-type: none"> Dam and barrier removal Water management Water rights acquisition 	Remove water retention structures and encourage water conservation in agriculture to return bottomland flooding closer to historical levels.
Invasive and other problematic species	Invasive plants like reed canarygrass (<i>Phalaris arundinacea</i>) have degraded many occurrences of this system.	<ul style="list-style-type: none"> Invasive species control 	Encourage fencing livestock away from sensitive riparian zones, non-native eradication, and restoration of riparian tree by planting.

Historical and contemporary land use practices have impacted hydrologic, geomorphic, and biotic structure and function of this riparian system throughout eastern Washington. A comparison of the historical and current extent shows that about 90 percent of the Columbia Basin Foothill Riparian Woodland and Shrubland Ecological System in Washington has either been lost or severely degraded. Much of this is the result of widespread land clearing for crops. Land use activities both within riparian areas as well as in adjacent uplands have fragmented many riparian reaches, which has reduced its connectivity with uplands.

Improperly managed grazing is another major influence that has altered the structure, composition, and function of this system. In general, the presence of livestock in arid riparian systems leads to less woody cover and an increase of undesirable plants. The degradation of this system also inhibits its influence on in-stream properties, such as maintaining water quality for the benefit of aquatic organisms. Although grazing and agriculture are the major stressor, this ecosystem has also been lost or degraded to the construction of roads, dams and other flood-control structures. While the widespread removal of beaver has reduced riparian habitat function, beaver recolonization in the interior Columbia River Basin has led to the rapid expansion of riparian habitat along incised streams. Climate change is also a concern because of this system's reliance on seasonal rainfall. Thus, increased drought frequency and duration are a concern.

Specific Ecological System References. (complete list at end of chapter)

- Kauffman, J. B., A. S. Thorpe, and E. N. J. Brookshire. 2004. Livestock exclusion and belowground ecosystem responses in riparian meadows of Eastern Oregon. *Ecological Applications* 14: 1671-1679.
- Pollock, M. M., T. J. Beechie, and C. E. Jordan. 2007. Geomorphic changes upstream of beaver dams in Bridge Creek, an incised stream channel in the interior Columbia River basin, eastern Oregon. *Earth Surface Processes and Landforms* 32: 1174-1185.

Sarr, D. A. 2002. Riparian livestock exclosure research in the western United States: a critique and some recommendations. *Environmental Management* 30: 516-526.

Trimble, S. W., and A. C. Mendel. 1995. The cow as a geomorphic agent: a critical review. *Geomorphology* 13: 233-253.

North Pacific Hardwood-Conifer Swamp

Conservation Status and Concern

Widespread logging has altered the structure and composition of most of these forested wetlands. To a lesser degree, other land uses have also impacted this system. Only a fraction of what remains has characteristics consistent with high ecological integrity. Eleven terrestrial SGCN are associated with this system, for which only the Oregon Spotted Frog is a closely associated species.

Description and Distribution

Most occurrences of North Pacific hardwood-conifer swamps in Washington are concentrated in the Pacific Northwest Coast Ecoregion, though patches are found sporadically in the West and North Cascades Ecoregions as well as in Puget Trough. The sizes of patches are mostly small and sporadically distributed in glacial depressions, river valleys, at the edges of lakes and marshes, and on slopes where there are seeps. Examples of this system mainly occur on flat to gently sloping lowlands below 1,500 feet elevation, though they are found in higher elevation forests when shallow soils occur over bedrock. This system is dominated by any one or a number of coniferous or hardwood species. Overstory canopy can be dense to relatively open (i.e. less than 50 percent). Shrub cover can also vary from dense to less than 50 percent. Soils are poorly drained while surface waters either move slowly or occur as stagnant pools. Groundwater or streams which do not experience significant overbank flooding are major contributors of water.

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes (Riparian; Freshwater Wetlands - Fresh Deepwater)	S2	Imperiled/ declining.	MAMMALS: Fisher, Hoary Bat, Keen's Myotis, Silver-haired Bat, Townsend's Big-eared Bat, Western Spotted Skunk
		Declines of 30-50 % within last 50 years.	BIRDS: Bald Eagle, Barrow's Goldeneye, Harlequin Duck, Marbled Murrelet, Western Screech Owl
		Declines of 70-80% from historic.	REPTILES/AMPHIBIANS: Oregon Spotted Frog*, Western Toad
			FISH: to be determined- research needed

* SGCN is closely associated with this ecological system

Stressors and Actions Needed

Forestry has greatly influenced the structure, composition, and function of hardwood-conifer swamps in Washington. Most stands previously comprised of older and mature forest are now younger second-growth stands. Logging has led to establishment of younger red alder (*Alnus rubra*) dominated forest where stands once consisted of various hardwood and conifer species capable of growth in saturated or seasonally flooded soils. Similar to the effects on tree composition, logging can change the composition of understory shrubs. With logging, diverse understories have given way to a much less varied shrub-layer, often dominated by salmonberry (*Rubus spectabilis*). As a secondary effect of logging, hardwood-conifer swamps have been degraded by the loss of large downed wood and snags. Logging has also negatively

impacted forested swamps by altering water quality (e.g., increased nutrients and sediments), hydrology, water temperatures, as well as microclimate. This in turn has harmed aquatic and semiaquatic species, especially those that require clean cool water.

Beyond forestry, other land use activities have impacted the ecological integrity of this system. Agricultural development and roads have decreased the extent of this system. Because of the hydrological connections to adjacent systems, nearby land use activities can alter the ecological integrity of hardwood-conifer swamp systems. Consequently, watershed scale conservation planning as well as the use of buffers and other on-site conservation actions are important to maintaining system integrity. Exotic species, such as reed canarygrass, has also threatened the ecological integrity of hardwood-conifer swamps in Washington.

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Forestry impacts	Forestry has led to widespread alteration of forest composition and structure. Salmonberry responds similarly to alder and tends to dominate the understory after logging.	<ul style="list-style-type: none"> Land use planning Vegetation management 	<p>Strengthen land use regulations (e.g., Forest Practices Act) as well as incentives to ensure adequate riparian buffers.</p> <p>Control invasive plants and reestablish native species to restore ecological function.</p>
Alteration of hydrology	Degraded water quality and altered hydrology resulting from land use negatively influence aquatic and semi-aquatic species.	<ul style="list-style-type: none"> Land use planning 	Strengthen land use regulations (e.g., Forest Practices Act) as well as incentives to ensure adequate riparian buffers.
Invasive and other problematic species	Invasive species such as reed canary grass and Himalayan blackberry can take over, especially at lower elevations.	<ul style="list-style-type: none"> Invasive species control 	Control invasive plants and reestablish native species to restore ecological function.

Specific Ecological System References. (complete list at end of chapter)

Chappell, C. B., and J. Kagan. 2001. Westside riparian-wetlands. Pages 94-96 in D. H. Johnson, and T. A. O'Neil, editors. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, OR.

North Pacific Lowland Riparian Forest and Shrubland

Conservation Status and Concern

By greatly influencing bottomland flooding, flood-control has altered the structure and composition of this lowland ecological system. Other land uses as well as ongoing threats from invasive species have also aided in the loss and degradation of this system. Thirty terrestrial SGCN are associated with this system, of which seven are closely associated species. Although a complete analysis has not been done for all SGCN anadromous and freshwater fishes, several appear closely associated with this system, e.g., Puget Sound

Chinook Salmon ESU, Lower Columbia Chinook Salmon ESU, Puget Sound Steelhead DPS, Lower Columbia Steelhead DPS, Lower Columbia Coho ESU, Hood Canal Summer Chum Salmon ESU, and Columbia River Chum Salmon ESU.

Description and Distribution

North Pacific Lowland Riparian Forest and Shrublands is a linear system that occurs on low-elevation, alluvial floodplains that are confined by valleys and inlets or lower terraces of rivers and streams. This ecological system is widely distributed across lowland western Washington in the Puget Trough, Pacific Northwest Coast, and West Cascade Ecoregions. Scattered occurrences also occur in the North and East Cascades and the Columbia Plateau Ecoregions. Riverine flooding and the succession that occurs after large flood events are the major drivers of this system. Consequently, this system does not develop under stagnant hydrological regimes. North Pacific Lowland Riparian Forest and Shrubland is primarily dominated by broadleaf species such as bigleaf maple (*Acer macrophyllum*), black cottonwood, and red alder, though in the absence of major disturbances conifers tends to increase.

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes Riparian	S2	Imperiled/ declining. Declines of 30-50% within last 50 years and from historical condition.	MAMMALS : Columbian White-tailed Deer*, Fisher, Gray Wolf, Hoary Bat, Keen's Myotis, Pacific Marten, Silver-haired Bat, Townsend's Big-eared Bat, Western Gray Squirrel, Western Spotted Skunk
			BIRDS : Bald Eagle, Peregrine Falcon, Slender-billed White-breasted Nuthatch, Western Bluebird
			REPTILES/AMPHIBIANS : Cascade Torrent Salamander*, Cope's Giant Salamander, Dunn's Salamander*, Larch Mountain Salamander, Olympic Torrent Salamander, Oregon Spotted Frog*, Van Dyke's Salamander, Western Toad
			FISH : to be determined- research needed
			INVERTEBRATES : California Floater, Puget Oregonian*, Barren Juga, Brown Juga*, Three-band Juga*, Dalles Sideband, Hoko Vertigo, Dalles Hesperian

* SGCN is closely associated with this ecological system

Stressors and Actions Needed

Historical and contemporary land use practices have significantly altered the hydrology and biotic structure and function of this riparian system. Roughly half of the historical extent of this system has been lost, while much of what remains is degraded. Land uses activities both within riparian areas as well as in adjacent uplands have fragmented the riparian zone along most reaches of stream where this system occurs. Forestry, conversion to croplands, and development are primary contributors to loss of North Pacific Lowland Riparian Forest and Shrublands in Washington. Reservoirs, water diversions, levees and other water control structures also have impacted hydrologic regimes important to maintaining this system. In particular, major flood control dams have greatly altered the frequency and intensity of bottomland flooding. This in turn has permanently inundated some areas while altering the vegetative structure and composition of others. The spread of exotic and invasive plants such as reed canarygrass and blackberry have also contributed to the system's degradation. All these disturbances have compromised the habitat

function of North Pacific Lowland Riparian Forest and Shrublands for terrestrial species and compromise the system's contributions to aquatic habitats and species (e.g., input of large wood to rivers and streams).

These forests and shrublands, adapted to high moisture levels and local flooding regimes driven by snowmelt and rainfall hydrology are likely to be affected by changes in hydrology and fluvial processes resulting from climate change (precipitation shifts, reduced snowpack, earlier snowmelt, drought and altered streamflow regimes).

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Dams, levees and Diversions	Greatly altering the frequency and intensity of bottomland flooding.	<ul style="list-style-type: none"> • Dam and barrier removal • Water management • Water rights acquisition 	Remove water retention structures and possible purchase of water rights to return bottomland flooding closer to historical levels.
Forestry impacts	Logging riparian forests results in the loss of terrestrial habitat, while indirectly impacting in-stream habitat conditions.	<ul style="list-style-type: none"> • Environmental review • Land acquisition • Private lands agreements 	Strengthen land use regulations (e.g., Forest Practices Act) as well as incentives to ensure adequate riparian management areas. Outreach to landowners to find mutual benefits.
Roads and development	Impacts hydrological regime (e.g., runoff) associated with increased impervious surfaces. Confinement of alluvial floodplains.	<ul style="list-style-type: none"> • Land use planning 	Strengthen land use regulations (e.g., Growth Management Act) as well as incentives to ensure adequate riparian management areas.
Climate change and severe weather	Impacting hydrology by altering seasonal inputs of water from rainfall and snowmelt.	<ul style="list-style-type: none"> • Research, survey or monitoring – habitat • Partner/stakeholder engagement 	Research to identify climate change effects and to identify most vulnerable riparian areas.

Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland

Conservation Status and Concern

The integrity of this system has been compromised across much of its range by land use activities that modify annual flooding and alter vegetative structure and composition. Twenty-four terrestrial SGCN are associated with this system, of which five are closely associated. Although a complete analysis has not been done for all SGCN anadromous and freshwater fishes, several appear closely associated with this system, e.g., Snake River Spring/Summer Chinook Salmon ESU, and Snake River Basin Steelhead DPS.

Description and Distribution

The Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland Ecological System consists of deciduous, coniferous, and mixed conifer-deciduous woodlands. In Washington, this system occurs mainly on public lands along streams and in floodplains within the lower montane and foothill zones of the Canadian Rocky Mountain, Blue Mountain, and Okanogan Ecoregions. It also sporadically is found along the lower slopes in the East Cascade Ecoregion. This system is maintained by annual flooding and wet soils and can take the form of woodlands, shrublands, wet meadows, and marshes. Beaver (*Castor Canadensis*) activity is an important driver of hydrological change. Black cottonwood is the key indicator species, while several other species, including quaking aspen, paper birch (*Betula papyrifera*), and water birch, can also be mixed among the canopy. Shrubs, ferns, and forbs associated with mesic conditions are also common.

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes (Riparian)	S2	Imperiled/ declining.	MAMMALS : Gray Wolf, Grizzly Bear, Hoary Bat, Preble's Shrew*, Silver-haired Bat, Townsend's Big-eared Bat, Western Spotted Skunk
		Decline of 10-39% within last 50 years.	BIRDS : Bald Eagle, Barrow's Goldeneye, Flammulated Owl, Golden Eagle, Harlequin Duck, Lewis' Woodpecker, Mountain Quail*, Peregrine Falcon
		Declines of 30-50% from historical condition.	REPTILES/AMPHIBIANS : Columbia Spotted Frog, Northern Leopard Frog*, Rocky Mountain Tailed Frog*, Tiger Salamander, Western Toad
			FISH : to be determined- research needed
			INVERTEBRATES : Meadow Fritillary*, Morrison's Bumblebee, Mission Creek Oregonian, Idaho Vertigo

* SGCN is closely associated with this ecological system

Stressors and Actions Needed

Almost all productive floodplain riparian zones in central and eastern Washington have been put into agriculture use. Because this system occurs at low to mid elevations, it is accessible to livestock and is highly attractive to congregating cattle. Pressure from livestock has caused both biotic and hydrologic changes to this system. These include severe changes to ecosystem composition, such as when prolonged grazing eliminates shrubs in favor of annuals such as Kentucky bluegrass. Other non-native and invasive species are brought about by grazing and by the pressures of other land uses. At stream edges, the combination of root loss and trampling from heavy grazing weakens and collapses banks. This can cause a stream to downcut, which can lower water tables and severely alter the hydrology of these riparian

systems. That in turn can further change and degrade the composition and structure of the riparian vegetation.

Although not as pervasive as grazing, croplands encroachment and logging have also led to the loss and degradation of this ecological system. Changes in hydrological regime caused by dams and water diversions as well as from the removal of beaver have influenced the spatial extent of the system and have altered peak and base flows. These changes can have substantial effect on both riparian plants and aquatic biota.

Climate change influences riparian ecosystems due to the reliance of these systems on water. River hydrology, especially in the arid west, responds to climate change through timing changes of spring snow melt, altered flood magnitudes, and reduced summer and base flows. This can shift riparian plant communities by favoring drought-tolerant species over drought-intolerant cottonwoods that are closely associated with Northern Rocky Mountain Lower Montane Riparian Woodland and Shrublands.

Land use activities both within riparian areas as well as in adjacent uplands have fragmented many riparian reaches, which has reduced riparian-upland connectivity. Degraded riparian habitat is also less able to beneficially influence adjacent streams (e.g., uptake of nutrients and pesticides from agriculture). Consequently, watershed scale conservation planning as well as the use of buffers and other on-site conservation tools are important to maintaining connectivity and system integrity.

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Agriculture and aquaculture side effects	Grazing practices incompatible with habitat conservation has impacted habitat structure and function.	<ul style="list-style-type: none"> Grazing/ farm management 	Encourage fencing livestock away from sensitive riparian zones.
Invasive and other problematic species	Invasive species become problematic when substrates are disturbed by grazing practices incompatible with habitat conservation.	<ul style="list-style-type: none"> Invasive species control 	Encourage fencing livestock away from sensitive riparian zones and control invasive plants and reestablish native species to restore ecological function.
Climate change and severe weather	Alteration of seasonal and annual flooding regimes will likely have adverse effects	<ul style="list-style-type: none"> Address existing stressors 	Addressing existing stressors can help build resilience to climate change impacts.

Specific Ecological System References. (complete list at end of chapter)

Hultine, K. R., S. E. Bush, and J. R. Ehleringer. 2010. Ecophysiology of riparian cottonwood and willow before, during, and after two years of soil water removal. *Ecological Applications* 20:347-361.

Kauffman, J. B., M. Mahrt, L. A. Mahrt, and W. D. Edge. 2001. Wildlife of riparian habitats. Pages 361-388 in D. H. Johnson, and T. A. O'Neil, editors. *Wildlife-habitat relationships in Oregon and Washington*. Oregon State University Press, Corvallis, Oregon.

- Kovalchik, B. L., and R. R. Clausnitzer. 2004. Classification and management of aquatic, riparian, and wetland sites on the national forests of eastern Washington: series description. USDA Forest Service General Technical Report PNW-GTR-593. Portland, Oregon.
- Perry, L. G., D. C. Andersen, L. V. Reynolds, S. M. Nelson, and P. B. Shafroth. 2012. Vulnerability of riparian ecosystems to elevated CO₂ and climate change in arid and semiarid western North America. *Global Change Biology* 18: 821-842.
- Poff, B. K., A. Karen, D. G. Neary, and V. Henderson. 2011. Threats to Riparian Ecosystems in Western North America: An Analysis of Existing Literature. *Journal of the American Water Resources Association* 47:1241-1254.
- Wissmar, R. C. 2004. Riparian corridors of eastern Oregon and Washington: functions and sustainability along lowland-arid to mountain gradients. *Aquatic Sciences* 66: 373-387

FRESHWATER AQUATIC VEGETATION, WET MEADOW, AND MARSH

Overview

The freshwater aquatic vegetation, wet meadow, and marsh vegetation formation includes 11 ecological systems comprised mainly of native herbaceous vegetation. Associated ecological systems occur at a broad range of elevations, climate conditions, and are widely distributed throughout Washington. They mostly occur in small patches, found primarily where there are hydric soils. Many of these systems are made up of diverse plant communities and are used by a wide range of Washington's SGCN. The wet meadow and marsh systems that occur in arid parts of the state are particularly important as refuge for native fauna during dry summer periods. Washington has lost an estimated 31 percent of its 1.35 million acres of wetlands. Although many wetlands that remain are of high ecological quality, others occur in a degraded state.

Climate changes such as drought, increasing temperatures, and changes in precipitation type, timing, and amount that alter hydrologic regimes and rates of evaporation and recharge may have significant impacts in wetland habitats. For example, these climate changes could lead to wetland drying, shifts in species assemblages (native and non-native), habitat conversion, and/or decreased quality and quantity of habitat available for aquatic biota. Changes in winter precipitation type and timing, as well as earlier runoff, could positively (e.g., create side channels or additional habitat) or negatively (e.g., reduced opportunities for water storage and recharge, increased erosion) impact these habitats.

Distribution	Public Land	Private Land	SGCN with close association (#)	SGCN with general association (#)	Ecological systems of concern (#)
559 mi ²	11%	89%	40	68	5

Major Stressors

- Dams and water management/use
- Invasive plants
- Pollution and degraded water quality
- Excess pressure from agriculture and grazing
- Loss of connectivity with uplands
- Climate Change

Habitat needs for SGCN associated with this system

Open habitat	Several amphibians (Oregon Spotted Frog, Western Pond Turtle, and Northern Leopard Frog) closely associated with some Freshwater Wet Meadow and Marsh ecological systems require open habitats with understory vegetation of low stature so eggs and egg masses will be exposed to sufficient sunlight.
High ecological integrity	The same amphibians that need open habitat are negatively affected by predators such as warm water fishes or bullfrogs (<i>Lithobates catesbeiana</i>) and when wetlands are invaded by aggressive plants such as reed canarygrass or plants such as the native broadleaf cattail (<i>Typha latifolia</i>) that may become aggressive when alterations to hydrology, nutrient and sediment regime produce an environment conducive to forming monotypic stands. Olympic Mudminnow and Tui Chub are likely closely associated with this system and require its ecological integrity throughout their life cycles.
High habitat connectivity	A number of closely associated SGCN have low mobility. Because many of these same species also require different types of habitats in close proximity to one another, wetlands with few barriers to adjacent uplands are preferred.

Actions needed to maintain habitat quality for SGCN

- Invasive plant and animal control.
- Habitat restoration and native plant restoration.
- Maintenance and/or restoration of a close approximation of system's natural hydrology.

Research and Data Needs

- Information on the effects of agricultural practices on wetland functions in the Pacific Northwest, especially in eastern Washington, is limited.
- Studies have examined whether projects using compensatory wetland mitigation met performance standards. However, few studies explore why performance standards are not met.
- Research on cumulative impacts to wetlands is mainly addressed from the perspective of direct wetland losses, and less from the perspective of degraded wetlands.
- Research on the effectiveness of wetland regulations and wetland rating systems for conserving species and important wetland functions and processes.

Ecological systems and other habitats discussed in greater detail in this chapter include:

- A. Temperate Pacific Freshwater Mudflat
- B. North Pacific Intertidal Freshwater Wetland
- C. North American Arid West Emergent Marsh
- D. Willamette Valley Wet Prairie
- E. Temperate Pacific Freshwater Emergent Marsh

Specific Ecological System References. (complete list at end of chapter)

Dahl, T. E. 1990. Wetland losses in the United States 1780's to 1980's. U. S. Fish and Wildlife Service, Washington, DC, USA.

North American Arid West Emergent Marsh

Conservation Status and Concern

North American arid west emergent Marshes provide important habitat for many migratory water birds as well other species that require shallow waters. It is also a particularly valuable source of moist habitat for fauna during dry summer periods in arid landscapes. Although a widespread system, almost all occurrences are degraded ecologically from their historical condition. Twenty terrestrial SGCN are associated with this system, eight of which are closely associated species. A complete analysis of habitat association has not been done for SGCN anadromous and freshwater fishes.

Description and Distribution

North American Arid West Emergent Marshes are widespread below the lower tree-line throughout the Columbia Plateau, and along the lower portions of the Canadian Rocky Mountain, and Okanogan Ecoregions. Typically represented as small wetland patches surrounded by savanna, shrub-steppe, or meadow-steppe vegetation, occurrences are sporadically distributed, mostly within depressions (e.g., ponds), along lake fringes, and near slow-flowing rivers and streams. Water chemistry can be highly variable, even within the same wetland complex and soils have hydric characteristics. Marshes are frequently inundated to water depths of up to 6 feet. For most of the growing season water can be found at or above the surface, although soils can become exposed by late summer. Plants adapted to waterlogged substrates dominate these wetlands and common emergent and floating vegetation include species of sedge, bulrush, rushes, pondweed, and pond-lily.

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes (Freshwater Wetlands - Fresh Deepwater)	S2	Imperiled/ declining. Declines of 30-50% within last 50 years and from historical condition.	MAMMALS: Hoary Bat, Kincaid Meadow Vole*, Silver-haired Bat, Spotted Bat, Townsend's Big-eared Bat
			BIRDS: American White Pelican, Bald Eagle, Barrow's Goldeneye, Cinnamon Teal*, Common Loon, Marbled Godwit, Peregrine Falcon*, Red-necked Grebe, Short-eared Owl, Upland Sandpiper*
			REPTILES/AMPHIBIANS: Columbia Spotted Frog, Northern Leopard Frog*, Tiger Salamander*, Woodhouse's Toad*
			FISH: to be determined- research needed
			INVERTEBRATES: Silver-bordered Fritillary*

* SGCN is closely associated with this ecological system

Stressors and Actions Needed

A variety of land use activities and stressors have negatively impacted this system. They range from development, grazing and agriculture, roads, invasive species, as well as the availability and quality of water. Grazing, invasive species, especially reed canarygrass, and altered hydrology have degraded almost every occurrence of this system in the Columbia Basin. Grazing practices that are incompatible with habitat conservation is a likely reason for the decreased abundance of native sedges and grasses, and an increase of invasive plants. Land use disturbance in contributing watersheds can contribute excess nutrients to marshes, which can also aid in the spread of invasive plants. Land use activities both within marshes as well as in adjacent uplands have likely reduced connectivity between wetland and upland habitats. Because

Bullfrogs have successfully spread throughout the low elevations of Washington State and is common to the Columbia Basin Ecoregion, this species likely occurs in this marsh system. As the frequency of severe droughts and air temperatures increase as a result of climate change, this will likely put further stress on this ecological system (e.g., wetlands drying out).

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Agriculture and aquaculture side effects	Spread of invasive plant species, particularly through grazing practices that are incompatible with habitat conservation.	<ul style="list-style-type: none"> • Invasive species control • Grazing/farm management • Private lands agreements 	Control invasive plants to maintain native species and restore ecological functions. Work with landowners to exclude livestock from marshes.
Alteration of hydrology	Hydrological alterations	<ul style="list-style-type: none"> • Water management • Water rights acquisition • Grazing/farm management • Private lands agreements 	Remove water retention structures and possible purchase of water rights to minimize loss of groundwater.
Climate Change and severe weather	Sensitive to increasing temperatures and changes in precipitation type, timing, and amount	<ul style="list-style-type: none"> • Research, survey or monitoring - habitat 	Activities to restore ecological function.
Invasive and other problematic species	Spread of invasive plant species, particularly through grazing practices that are incompatible with habitat conservation.	<ul style="list-style-type: none"> • Invasive species control • Grazing/farm management • Private lands agreements 	Control invasive plants to maintain native species and restore ecological functions. Work with landowners to exclude livestock from marshes.

Specific Ecological System References. (complete list at end of chapter)

Hallock, L. A., and K. R. McAllister. 2009. American Bullfrog. Washington Herp Atlas.
<http://www1.dnr.wa.gov/nhp/refdesk/herp/>

North Pacific Intertidal Freshwater Wetland

Conservation Status and Concern:

Hydrological modifications, especially those which alter tidal exchange, have negatively affected the ecological processes and species associated with this system. This and other disturbances such as spread of invasive plants have contributed to significant declines in spatial extent and ecological integrity of North Pacific Intertidal Freshwater Wetlands in Washington. Nine terrestrial SGCN are associated with this system, of which the Columbian White-tailed Deer and Peregrine Falcon are closely associated. A complete analysis of habitat association has not been done for SGCN anadromous and freshwater fishes.

Description and Distribution

North Pacific Intertidal Freshwater Wetland is a small-patch, tidally influenced freshwater ecological system that forms as narrow strips as well as more extensive patches of habitat. It occurs primarily in the Puget Trough and Pacific Northwest Coast Ecoregions. More specifically occurrences are found in bays and inlets of Washington's southern outer coast, at outlets of large rivers that discharge into Puget Sound (e.g., Skagit River Delta), and along the Columbia River and its tributaries downstream of Bonneville Dam. Although little detailed vegetation data has been collected for this system, plants communities are complex and can include patches dominated by trees, shrubs or herbaceous species.

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes (Freshwater Wetlands - Fresh Deepwater)	S1	Critically imperiled/ declining. Decline of 50-70% within last 50 years and from historical condition.	MAMMALS : Columbian White-tailed Deer*, Hoary Bat, Silver Haired Bat
			BIRDS : Peregrine Falcon*, Bald Eagle, Barrow's Goldeneye, Red Necked Grebe, Sandhill Crane (Greater)
			FISH : to be determined- research needed

* SGCN is closely associated with this ecological system

Stressors and Actions Needed

An estimated 90 percent of Puget Sound freshwater tidal wetlands have been lost, while lesser but still significant losses are documented in the Columbia River System. Hydrological modifications, especially those that alter tidal exchange (e.g., jetties, dikes, and dams) have contributed to these losses. Direct alterations of hydrology (i.e., channeling, draining, damming) as well as indirect alterations (e.g., roads on adjacent slopes) have likely also changed the locations of these types of wetlands. Water control structures have degraded the ecological processes and species composition linked to this system by substantially altering the processes that maintain this system. Where there have been long term changes in flow, these wetlands have sometimes reestablished to reflect the new hydrology (e.g., broadleaf cattail can be an aggressive invader).

Although harvesting timber in wetlands is now regulated, many occurrences were historically logged. Logging and other activities within wetlands as well as in adjacent uplands have likely also reduced wetland connectivity with upland habitat. Most remaining occurrences of North Pacific Intertidal Freshwater Wetlands are degraded to some extent by invasive weeds, such as reed canarygrass, giant knotweed (*Polygonum sachalinense*), and purple loosestrife (*Lythrum salicaria*).

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Dams, levees and diversions	Hydrological alterations (especially those which alter tidal exchange)	<ul style="list-style-type: none"> • Dam and barrier removal • Hazard removal • Instream modification 	Restore hydrological processes by removing or modifying in-stream and near shore barriers inhibiting historical hydrological regime
Fish and wildlife habitat loss or degradation	Reduced connectivity with uplands	<ul style="list-style-type: none"> • Dam and barrier removal • Create new habitat or natural processes 	Remove barriers inhibiting habitat connectivity to restore ecological function.
Invasive and other problematic species	Invasive plants	<ul style="list-style-type: none"> • Invasive species control 	Control invasive plants and reestablish native species to restore ecological function.

Specific Ecological System References. (complete list at end of chapter)

Fresh K., M. Dethier, C. Simenstad, M. Logsdon, H. Shipman, C. Tanner, T. Leschine, T. Mumford, G. Gelfenbaum, R. Shuman, and J. Newton. 2011. Implications of Observed Anthropogenic Changes to the Nearshore Ecosystems in Puget Sound. Prepared for the Puget Sound Nearshore Ecosystem Restoration Project. Technical Report 2011-03.

Marcoe, K., and S. Pilson. 2012. Land cover change in the Lower Columbia River Estuary, 1880 – 2011. Poster presented at The Columbia River Estuary Conference. May 15 to 17, 2012, Astoria, Oregon.

Temperate Pacific Freshwater Emergent Marsh

Conservation Status and Concern:

Although Temperate Pacific Freshwater Emergent Marshes remain widespread on the landscape, much, if not most of it is in a degraded condition. The system has also likely experience significant decline in its extent in Washington. Twenty-one terrestrial SGCN are associated with this system, five of which are closely associated species. A complete analysis of habitat association has not been done for SGCN anadromous and freshwater fishes.

Description and Distribution

Dominated by herbaceous vegetation, this system occurs as small patches mainly in lowlands. In Washington, Temperate Pacific Freshwater Emergent Marshes are most abundant in the Puget Trough Ecoregion, though it occurs throughout the Pacific Northwest Coast and North Cascades Ecoregions and in sporadic locations across the foothills of the East and West Cascades. This freshwater system ranges from seasonally to permanently flooded wetlands found in depressions, along streams, and shorelines. A consistent freshwater source is essential to the function of this system. Therefore, waters generally remain at or above the surface, though water levels can radically fluctuate and by late summer bare soil can become exposed. Waters are nutrient rich, which favor aggressive species and low plant species diversity. Vegetation is frequently made up of graminoids (e.g., grasses, sedges, rushes), though forbs can be present. Trees, shrubs and non-vascular plants are typically absent or sparse.

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes Freshwater Wetlands, Freshwater Deepwater	S2	Imperiled/ declining Decline of 10 to 30% within last 50 years and from historical condition.	MAMMALS: Columbian White-tailed Deer, Hoary Bat, Keen's Myotis, Shaw Island Vole, Silver-haired Bat, Townsend's Big-eared Bat
			BIRDS: Bald Eagle, Barrow's Goldeneye, Cinnamon Teal*, Dusky Canada Goose, Harlequin Duck, Peregrine Falcon*, Purple Martin, Sandhill Crane (greater), Short-eared Owl
			REPTILES/AMPHIBIANS: Columbia spotted frog, Oregon spotted frog*, Tiger Salamander*, Western Toad, Western Pond Turtle*
			FISH: to be determined- research needed

* SGCN is closely associated with this ecological system

Stressors and Actions Needed

Although most wetlands now receive regulatory protections, historical filling and draining certainly led to the direct loss of these wetlands. In addition to direct losses, alterations to this system have occurred from activities like diking, urban development, and agricultural. Given that a high concentration of these wetlands are in populous regions of the state, urban development pressures have certainly taken a toll on this ecological system. Such influences include altered hydrology associated with runoff over impervious surfaces. It also includes the flush of nutrients and toxic contaminants into wetlands from roads and development.

Development has also fragmented these wetlands from other nearby wetlands as well as from adjacent uplands. Similar to other types of wetlands, many Temperate Pacific Freshwater Emergent Marshes are

degraded by invasive plants. Broadleaf cattail is a native species that can become a particularly problematic invader when ecological conditions have been altered. With the spread of Bullfrogs throughout the lowlands of Washington, especially in the Puget Sound Region, this non-native predator is now common to marsh systems in this region. Conversely, the widespread trapping of beaver has diminished the positive role that this species used to play in creating and maintaining wetlands throughout the state.

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Invasive and other problematic species	Invasive plants	<ul style="list-style-type: none"> Invasive species control 	Control invasive plants and reestablish native species to restore ecological function.
Invasive and other problematic species	Bullfrog use of wetland.	<ul style="list-style-type: none"> Invasive species control 	Control bullfrogs, especially where they coexist with vulnerable SGCN.
Roads and development	Impacts hydrological regime (e.g., runoff) associated with increased impervious surfaces. Confinement of alluvial floodplains.	<ul style="list-style-type: none"> Land use planning 	Strengthen land use regulations (e.g., Growth Management Act) as well as incentives to help encourage compatible development, such as Low Impact Development techniques.

Specific Ecological System References. (complete list at end of chapter)

Hallock, L. A., and K. R. McAllister. 2009. American Bullfrog. Washington Herp Atlas.

<http://www1.dnr.wa.gov/nhp/refdesk/herp/>

MacKenzie, W. H., and J. R. Moran. 2004. Wetlands of British Columbia: a guide to identification. Research Branch, B.C. Ministry of Forestry, Victoria, British Columbia.

Temperate Pacific Freshwater Mudflat

Conservation Status and Concern

Temperate Pacific Freshwater Mudflat Ecological Systems provide important habitat, especially as a migratory stopover for shorebirds to rest and feed. This ecological system has decreased from its historical extent in Washington, primarily because of a significantly altered flooding regime. Five terrestrial SGCN are associated with this system, of which only the Cinnamon Teal are closely associated. A complete analysis of habitat association has not been done for SGCN anadromous and freshwater fishes.

Description and Distribution

This small patch system ranges from sparsely vegetated to extensive sods of herbaceous vegetation. The system occurs in seasonally flooded shallow floodplain mudflats, especially along the estuarine waters of the lower Columbia River in the Pacific Northwest Coast Ecoregion. Plants supported by these mudflats typically are annuals of low stature.

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes (Freshwater Wetlands - Fresh Deepwater)	S1	Critically imperiled. Decline of 50-70% in last 50 years and from historical condition.	BIRDS: Cinnamon Teal*, Bald Eagle, Canada Goose, Peregrine Falcon
			FISH: to be determined- research needed
			INVERTEBRATES: Columbia River Tiger Beetle

* SGCN is closely associated with this ecological system

Stressors and Actions Needed

Hydrological alterations in the upper Columbia River drainage (e.g., large mainstem river dams) have likely decreased the extent of this system due to reduced sediment loads carried downstream and because of changes in flooding regime. River bottom dredging has also likely removed the sediment source required to maintain mudflats, while non-native species has also impacted the system.

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Energy development and distribution	Hydropower alters frequency and intensity of bottomland flooding and sediment inputs.	<ul style="list-style-type: none"> Water management 	Negotiations with dam operators during relicensing to influence ecosystem.
Invasive and other problematic species	Excess nutrients lead to establishment of non-native or invasive plants.	<ul style="list-style-type: none"> Invasive species control Planting/seeding 	Removing invasive flora.

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Fish and wildlife habitat loss or degradation	Dredging activities can result in removal of sediments needed for mudflat development and maintenance.	<ul style="list-style-type: none"> Create new habitat or natural processes Living shorelines 	Work with Corps of Engineers on mudflat restoration (e.g., creating new mudflats with dredging spoils).

Willamette Valley Wet Prairie

Conservation Status and Concern

Willamette Valley Wet Prairie Ecological System has been nearly extirpated in Washington. Sixteen terrestrial SGCN are associated with this system; seven species mainly comprised of butterflies are closely associated species. A complete analysis of habitat association has not been done for SGCN anadromous and freshwater fishes.

Description and Distribution

This system is mainly restricted to oak/prairie landscapes of South Puget Sound as well as parts of Lewis, Cowlitz, and Clark Counties (hereafter referred to as Willamette Valley). Wet prairie is dominated by a highly diverse community of grasses and sedges and to a lesser degree by forbs or shrubs. In fire-maintained prairie landscapes, wet prairies occur in areas with seasonally high water tables. Although likely extirpated, South Puget Sound wet prairie occurred in low-lying sites with open topography and few barriers to isolate them from historically frequent fires. In the permeable, glacial outwash substrates of the region, wet prairies were most likely limited to swales and along low-gradient riparian areas where aquifers were perched close to the surface. The wet prairies of South Puget Sound contrast with Willamette Valley wet prairies, in that the latter generally occurs on fairly impermeable, clay-rich soils. Although Willamette Valley wet prairie once covered a large area, it now is likely restricted to scattered small patches of habitat.

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes Westside Prairie	S1	Critically imperiled/ declining. Declines of >90% in last 50 years and from historical condition.	MAMMALS: Brush Prairie Pocket Gopher, Silver-haired Bat, Townsend's Big-eared Bat, Western Pocket Gopher
			BIRDS: Bald Eagle, Cinnamon Teal, Oregon Vesper Sparrow, Short-eared Owl, Streaked Horned Lark, Western Bluebird*
			FISH: to be determined- research needed
			INVERTEBRATES: Taylor's Checkerspot*, Oregon Branded Skipper*, Mardon Skipper*, Sonora Skipper*, Puget Sound Fritillary*, Valley Silverspot*

* SGCN is closely associated with this ecological system

Stressors and Actions Needed

In the wet prairie swales of the South Puget Sound, relatively high site productivity resulted in their rapid conversion to agricultural use, intense grazing pressure from livestock, and rapid invasion by dense, woody

vegetation in the absence of regular fires. In addition, the hydrology of many sites has been altered by draining, agriculture, roads, recession of the ground water table (due to wells), and lack of fire. As a result, native prairie vegetation in wet prairie swale habitat has been extirpated in South Puget Sound and may be close to meeting the same fate in southwest Washington.

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Fish and wildlife habitat loss or degradation	Habitat is nearly extirpated from Washington	<ul style="list-style-type: none"> • Private lands agreements • Conservation area designation • Land acquisition • Habitat restoration 	Work through regulatory and non-regulatory channels (e.g., conservation easements) to protect known extant wet prairie locations.
Resource information collection needs	Insufficient knowledge of the location of remaining wet prairie habitat, especially on private lands, where access is limited.	<ul style="list-style-type: none"> • Research, survey or monitoring - habitat 	Identify extent of remaining wet prairie by gaining access to sites with likelihood of locating habitat.

Specific Ecological System References. (complete list at end of chapter)

- Altman, B., M. Hayes, S. Janes, and R. Forbes. 2001. Wildlife of westside grassland and chaparral habitats. Pages 261-291 in D. H. Johnson and T. A. O'Neil, Managing Directors. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, Oregon.
- Caplow, F., and J. Miller. 2004. Southwestern Washington prairies: using GIS to find rare plant habitat in historic prairies. Washington Department of Natural Resources, Olympia, Washington.
- Chappell, C. B., E. A. Alverson, and W. R. Erickson. 2004. Ecologic and geographic variation in species composition of prairies, herbaceous balds, and oak woodlands of the Willamette Valley-Puget Trough-Georgia Basin Ecoregion. Abstract: Ecological Society of America, August 1 - 6, 2004, Portland Convention Center, Oregon.
- Easterly, R. T., D. L. Salstrom, and C. B. Chappell. 2005. Wet prairie swales of the South Puget Sound, Washington. Report prepared for The Nature Conservancy, South Sound Office, Olympia, Washington.

GRASSLAND, MEADOW, AND SHRUBLAND

Overview

Grasslands, meadows, and shrublands include 12 ecological systems comprised of native upland vegetation throughout a broad elevational and climactic range in Washington. They vary from dry subalpine grasslands to prairies to western Washington balds and bluffs, to deciduous shrublands and subalpine meadows to dry canyon grasslands and prairies of eastern Washington. They do not include ecological systems associated with deserts, wetlands, alpine, disturbed, urban, coastal dune and tidal vegetation. A total of 31 SGCN are closely associated with grasslands, meadows and shrublands, and 61 SGCN are generally associated.

Distribution	Public Land	Private Land	SGCN with close association (#)	SGCN with general association (#)	Ecological systems of concern (#)
3,713 mi ²	46%	54%	31	61	3

Major stressors

Wildlife habitat loss and degradation, invasive plants and animals (including invading native species), Fire suppression and climate change.

Habitat needs for SGCN associated with this system

Deep soils	Several species (Mazama Pocket Gopher, Olympic Marmot, Badger, Western Pond Turtle) require soils that are relatively deep and suitable for burrowing. These species also provide natural disturbance in grassland habitats. Deep soil habitats are more suitable for agriculture and are sensitive to accelerated succession due to fire suppression and climate change.
High micro-climate diversity	Many of the butterflies use habitat of high microclimate diversity with few invasive plants and high diversity of native plants.
High ecological integrity	Some of the birds (Streaked Horned Lark, Oregon Vesper Sparrow) and butterflies (Taylor's Checkerspot, Mardon Skipper, Oregon Branded Skipper, Sonora Skipper) require short-stature vegetation provided by native species, and are sensitive to invasive shrubs and grasses. Ecological integrity of this habitat's riparian areas is important for SGCN interior Columbia basin anadromous salmonids and freshwater fishes.

Actions needed to maintain habitat quality for SGCN

- Fire management (establishment of natural fire regimes and prescribed fire),
- Grazing, agriculture, and farm management,
- Invasive species control,
- Habitat restoration, research, and native species restoration).

Ecological systems discussed in greater detail in this chapter

Of the 12 ecological systems found in this formation, the following three are discussed in greater detail.

- A. Columbia Basin Foothill and Canyon Dry Grassland,
- B. Columbia Basin Palouse Prairie,
- C. Willamette Valley Upland Prairie and Savanna.

Columbia Basin Foothill and Canyon Dry Grassland

Conservation Status and Concern

Columbia Basin Foothill and Canyon Dry Grasslands occur over 1,450 square miles in eastern Washington. Degradation in condition is the major cause of conservation need. Cheatgrass (*Bromus tectorum*) and other annual bromes are widespread on south aspects. Exotic weeds also commonly invade this system on the north aspects.

Description and Distribution

Columbia Basin Foothill and Canyon Dry Grassland Ecological Systems occur on steep open slopes, from 300 to 5000 feet elevation in the canyons and valleys of the Columbia Plateau Ecoregion, particularly along the Snake River canyon and large tributaries. It typically occurs at and well below lower treeline. It is floristically similar to the Columbia Basin Palouse Prairie but is distinguished by landform, soil, and process characteristics. Perennial bunchgrasses and forbs (usually over 25 percent cover) dominate these grasslands. Annual precipitation is low 5 to 10 inches that occurs mostly in the winter, primarily as rain. Fire frequency is presumed to be less than 20 years; the return interval may have been as low as 5 to 10 years. Elk, deer and bighorn sheep are native large grazers in the canyon who used particularly in winter and spring.

There are four terrestrial SGCN that are considered closely associated with this ecological system. They are all birds; Columbian Sharp-tailed Grouse, Greater Sage-grouse, Ferruginous Hawk, and Golden Eagle. An additional 28 terrestrial species are generally associated with this system. Although a complete analysis has not been done for all SGCN anadromous and freshwater fishes, several appear closely associated with this system, e.g., Snake River Basin Steelhead DPS, and Snake River Spring/Summer Chinook Salmon ESU.

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Eastside Steppe	S1-S2	Imperiled/ declining Decline of 30 – 50% in last 50 years Decline of >90% from historical conditions.	MAMMALS: American Badger, White-tailed Jackrabbit, Washington Ground Squirrel, Townsend's Big-eared Bat, Spotted Bat, Silver-haired Bat, Merriam's Shrew, Hoary Bat.
			BIRDS: Bald Eagle, Mountain Quail, Loggerhead Shrike, Short-eared Owl, Peregrine Falcon, Greater Sage Grouse*, Sharp-tailed Grouse*, Ferruginous Hawk*, Burrowing Owl, and Golden Eagle*.
			AMPHIBIANS: Columbia Spotted Frog, Tiger Salamander, Western Toad
			FISH: to be determined- research needed
			INVERTEBRATES: Morrison's Bumblebee, Poplar Oregonian, Giant Palouse Earthworm, Hoder's Mountainsnail, Ranne's Mountainsnail, Limestone Point Mountainsnail.

*SGCN closely associated with this ecosystem.

Stressors and Actions Needed

Two important attributes not mentioned above are the relative cover of native bunchgrass and condition of the biological soil crust. The primary land uses that alter the natural processes of this system are associated with livestock practices, annual exotic species invasion, fire regime alteration, direct soil surface disturbance, and fragmentation. Excessive grazing stresses the system through soil disturbance, diminishing or eliminating the biological soil crust, altering the composition of perennial species, and increases the establishment of annual grasses, particularly cheatgrass and other exotic annual bromes. Increasing habitat quality is the primary action needed to restore ecological integrity.

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Altered disturbance regimes	Fire exclusion has resulted in shrub encroachment, loss of habitat diversity	<ul style="list-style-type: none">• Fire management• Vegetation management	Integrated Habitat Restoration using prescribed fire, weed control and seeding with natives
Invasive and other problematic species	Invasive forbs and shrubs are degrading native grassland	<ul style="list-style-type: none">• Invasive species control	Mechanical and herbicide control of exotics
Agriculture and aquaculture side effects	Excessive grazing and accelerating weed invasions	<ul style="list-style-type: none">• Grazing/farm management• Invasive species control• Planting/seeding• Private lands agreements	Conservation easements, landowner agreements, and restoration. Integrated habitat restoration using prescribed fire, weed control and seeding with natives

Specific Ecological System References (complete list at end of chapter)

Tisdale, E.W. 1986. Canyon grasslands and associated shrublands of west-central Idaho and adjacent areas. Bulletin 40. Forestry, Wildlife and Range Experiment Station, University of Idaho, Moscow.
(Landfire 2007)

Columbia Basin Palouse Prairie

Conservation Status and Concern

This once extensive grassland is now limited to small patches, as over 90 percent of the original prairie was converted to agricultural uses. The remaining patches remain subject to weed and native shrub invasion.

Description and Distribution

The Columbia Basin Palouse Prairie Ecological System was once an extensive grassland system within the Columbia Plateau Ecoregion in southeast Washington and adjacent Idaho and Oregon. It was characterized by dense bunchgrass cover on a dune-like topography composed of loess hills and plains over basalt informally called the Palouse loess. Remnant prairies are now typically associated with small, steep and rocky sites or small, isolated sites within an agricultural landscape. The associated

climate of the Palouse Prairie is generally warm to hot, dry summers and cool, wet winters. Annual precipitation is high, (15 to 30 inches) and the soils were typically deep, well-developed, and old. There are four terrestrial SGCN that are considered closely associated with this ecological system. They are all birds (see table below). An additional 12 terrestrial species are generally associated with this system, and include Tiger Salamander, Short-eared Owl, Peregrine Falcon, Burrowing Owl, Cinnamon Teal, Hoary Bat, Silver-haired Bat, Townsends Big-eared Bat, White-tailed Jackrabbit, American Badger, Washington Ground Squirrel, and Giant Palouse Earthworm. A complete analysis of habitat association has not been done for SGCN anadromous and freshwater fishes.

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Eastside Steppe	S1	Critically imperiled/ declining. Decline of 10-30% within the last 50 years. Decline of >90% from historical condition.	MAMMALS: Hoary Bat, Silver-haired Bat, Townsends Big-eared Bat, White-tailed Jackrabiit, American Badger, Washington Ground Squirrel
			BIRDS: Greater Sage-grouse*, Sharp-tailed Grouse*, Ferruginous Hawk*, Golden Eagle*, Short-eared Owl, Peregrine Falcon, Burrowing Owl, Cinnamon Teal.
			AMPHIBIANS: Tiger Salamander
			FISH: to be determined- research needed
			INVERTEBRATES: Giant Palouse Earthworm

* SGCN is closely associated with this ecological system

Key Stressors and Actions Needed

The primary land uses that alter the natural processes of the Columbia Plateau Palouse Prairie system are associated with agricultural and livestock practices, exotic species, fire regime alteration, direct soil surface disturbance, and fragmentation. Fire further stresses livestock-altered vegetation by increasing exposure of bare ground and consequent increases in exotic annuals and decrease in perennial bunchgrass. Fire suppression leads to deciduous shrubs, such as snowberry (*Symphoricarpos* spp.), ninebark (*Physocarpus malvaceus*), oceanspray (*Holodiscus discolor*), and currant (*Ribes* spp.) and in some areas ponderosa pine and Douglas-fir (*Pseudotsuga menziesii*).

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Altered disturbance regimes	Fire exclusion has resulted in shrub encroachment, loss of habitat diversity	<ul style="list-style-type: none"> Fire management Invasive species control 	Integrated Habitat Restoration using prescribed fire, weed control and seeding with natives
Invasive and other problematic species	Invasive forbs and shrubs are degrading native grassland	<ul style="list-style-type: none"> Fire management Invasive species control 	Mechanical and herbicide control of exotics

Willamette Valley Upland Prairie and Savanna

Conservation Status and Concern

Due to historical losses in habitat, and ongoing threats from invasive species and development, conservation action is critical for conservation of this ecological system and associated SGCN. There are 15 terrestrial SGCN that are considered closely associated with this ecological system (see table below). There are an additional 8 terrestrial species that are considered generally associated with this ecological system. A complete analysis of habitat association has not been done for SGCN anadromous and freshwater fishes.

Description and Distribution

The Willamette Valley Upland Prairie and Savanna is a grassland and savanna system endemic to the Willamette Valley Ecoregion and Puget Lowlands. In Washington, it is most expansive in the south Puget Sound (e.g., Pierce and Thurston Counties) and is also found in the San Juan Islands and in southwestern Washington. Most sites experience extreme soil drought in the summer. In the South Puget Sound, this system occurs as large patches, usually associated with deep, gravelly/sandy glacial outwash that is excessively well drained within more forested landscapes. Landforms are usually flat, rolling, or gently sloping, and often part of extensive plains.

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes Westside Prairie	S1	Critically imperiled, declining.	MAMMALS: Mazama Pocket Gopher*, Western Gray Squirrel, Townsends Big-eared Bat, Silver-haired Bat, Hoary Bat, and Brush Prairie Pocket Gopher.
		Decline of 30% within the last 50 years.	BIRDS: Streaked Horned Lark*, Oregon Vesper Sparrow*, Western Bluebird*, Short-eared Owl, and Bald Eagle.
		Decline of > 90% from historical condition.	REPTILES/Amphibians: Western Pond Turtle* and Western Toad.
			FISH: to be determined- research needed
			INVERTEBRATES: Taylor's Checkerspot*, Mardon Skipper*, Puget Blue*, Valley Silverspot*, Puget Sound Fritillary*, Sonora Skipper*, Island Marble*, Oregon Branded Skipper*, Propertius Duskywing*, and Hoary Elfin*.

* SGCN is closely associated with this ecological system

Stressors and Actions Needed

The exclusion of fire from most of this system over the last 100 plus - years has resulted in the loss of oak savanna from the landscape and the encroachment of Douglas-fir, except perhaps on the very driest sites. This encroachment leads to the conversion of prairies and savannas to forests. Fire exclusion has also resulted in increases in shrub cover and the conversion of some prairies to shrublands. Nonnative species generally increase after ground-disturbing activities. The dominant native grass, Roemer's Fescue (*Festuca roemerii*), and many herbaceous species are threatened by the uncontrolled spread of Scot's broom (*Cytisus scoparius*). Prescribed fire and other management tools have been used recently in some areas to control Scot's broom and Douglas-fir encroachment, and to attempt to mimic historical conditions.

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Altered disturbance regimes	Fire exclusion has resulted in tree and shrub encroachment, loss of habitat diversity	<ul style="list-style-type: none"> • Fire management • Vegetation management 	Integrated habitat restoration using prescribed fire, weed control and seeding with natives
Invasive and other problematic species	Invasive forbs and shrubs are degrading native prairie	<ul style="list-style-type: none"> • Fire management • Invasive species control 	Mechanical and herbicide control of exotics
Roads and development	Habitat has been fragmented and lost to housing and subdivisions	<ul style="list-style-type: none"> • Environmental review • Land acquisition • Land use planning • Private lands agreements 	Acquisition, conservation easements, landowner agreements, and restoration

HERBACEOUS AGRICULTURAL VEGETATION

Overview

Herbaceous Agricultural Vegetation includes both cultivated croplands and pastures and hay. Cultivated croplands can be defined as areas used for the production of annual crops, as well as perennial woody crops such as orchards and vineyards. It includes all lands that are actively tilled. Pastures are defined as areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically as a perennial planting (for example, fields). Conservation Reserve Program fields provide perennial grasslands used by a suite of grassland birds and are an important part of the landscape for Greater Sage-grouse, a Species of Greatest Conservation Need.

Each of these types of habitat can, under certain conditions, support a relatively large number of Species of Greatest Conservation Need (see table below). This may be, in part, due to the high diversity of agricultural lands, including diversity in elevation, highly productive soils, locations in valley bottoms and/or near rivers and streams, and distribution throughout the state. The annual or frequent disturbance associated with agricultural lands makes them valuable seasonally to many wildlife species. Ephemeral or farmed wetlands can be valuable places for overwintering waterfowl, breeding sites for amphibians, and food for many species during certain times of the year. Other features of the agricultural environment, including water developments, buildings and farm structures, roadsides, field borders, fence rows, and windbreaks can provide valuable habitat for wildlife .

Four terrestrial SGCN are considered to have close association with herbaceous agricultural vegetation. These are the Oregon Spotted Frog, Woodhouse's Toad, Dusky Canada Goose, and Gray-tailed Vole. For these species, agricultural lands should be considered essential for their continued conservation. For other species with general association, agricultural lands may provide important habitats, by providing important food, for example, and may be as important as habitat found in ecological systems of the natural landscape. Agricultural lands border many rivers and streams, especially in the interior Columbia Basin, and thus are

associated with many anadromous and freshwater SGCN fishes. Although a complete analysis has not been done for all SGCN anadromous and freshwater fishes, several appear closely associated with this system, e.g., Middle Columbia Steelhead DPS, Upper Columbia Steelhead DPS, Upper Columbia Spring Chinook salmon ESU, and likely Bull trout-Mid-Columbia Recovery Unit.

Distribution	Public Land	Private Land	SGCN with close association (#)	SGCN with general association (#)	Ecological systems of concern (#)
13,354 mi ²	7%	93%	11	52	0

Major Stressors

- Annual disturbance – timing is key to understanding impacts to wildlife. Changes in disturbance regimes and areas disturbed also may significantly impact wildlife.
- Agricultural chemicals, including pesticides and fertilizers – choice of chemical, timing of exposure, and number of chemicals applied and rate of application are key to understanding impacts to wildlife and fishes.
- Increased predation by various predators, including corvids, gulls, canids, raccoons, opossums, skunks and rodents.

Habitat needs for SGCN associated with this system

Reduce pesticide impacts	Reduce pesticide impacts through chemical selection, timing, amount of chemical applied and adoption of integrated pest management strategies.
Enhance fencerows, borders, windbreaks, and roadsides	Selection of appropriate species for planting in these areas, timing of disturbances like mowing to reduce impacts, maintenance of uncultivated and undisturbed strips of vegetation, and protection of these habitats from disturbances such as excessive grazing, vehicle traffic, etc..
Maintain riparian buffer native vegetation	Adequately functioning riparian habitat is needed for anadromous and freshwater SGCN fishes

Actions needed to maintain habitat quality for SGCN

- Continue programs that help agricultural lands provide wildlife habitat, principally Natural Resources Conservation Service and Farm Services Agency programs like the Wetland Reserve Program, Conservation Reserve Program, Environmental Quality Incentives Program, and the Resource Conservation and Development Program.
- Identify important connectivity areas in developing landscapes to help jurisdictions plan future growth.
- Continued support for programs that help educate landowners on ways to manage agricultural lands to help benefit wildlife and fishes.

Research and Data Needs

Key needs for continued research include understanding how agricultural production affects wildlife at the landscape scale, investigating the optimum patch size and landscape context for farmland set-aside

programs to benefit grassland and shrubsteppe wildlife, continued work on benefits of integrated pest management to wildlife, and specific habitat enhancements for Species of Greatest Conservation Need.

Specific Ecological System References. (complete list at end of chapter)

- Edge, W. D. 2001. Wildlife of Agriculture, Pastures, and Mixed Environs. Pages 342-360 in D. H. Johnson, and T. A. O'Neil, editors. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, OR.
- Schroeder, M. A. and W. M. Vander Haegen. 2011. Response of greater sage-grouse to the Conservation Reserve Program in Washington State. *Studies in Avian Biology* 38:517-529.
- Vander Haegen, W. M., M. A. Schroeder, W. Y. Chang, and S. M. Knapp. 2015. Avian abundance and reproductive success in the intermountain west: Local-scale response to the conservation reserve program. *Wildlife Society Bulletin* (In Press).

INTRODUCED AND SEMI-NATURAL

Overview

Introduced and Semi-Natural Vegetation includes 5 systems that are considered human influenced or made, 1) introduced riparian and wetland vegetation, and introduced upland vegetation: 2) annual grasslands, 3) perennial grasslands, 4) shrublands, and 5) treed. These are considered spontaneous, self-perpetuating, and not (immediately) the result of planting, cultivation, or human maintenance. Land occupied by introduced vegetation is generally permanently altered (converted) unless restoration efforts are undertaken. Natural vegetation types are usually no longer recognizable. Land cover is significantly altered/disturbed by introduced wetland, grassland, shrubland, and tree species. Examples of these include: reed canarygrass invasions in wetland systems, Scot's broom invasions into upland grassland systems, cheatgrass invasions into shrub-steppe systems, and Russian olive along riparian systems in Eastern Washington.

Wildlife use of these habitats include, for example, Burrowing Owl use of disturbed vegetation in deep soils along irrigation canals in eastern Washington, Washington Ground Squirrel use of old grazed fields invaded by bulbous bluegrass (*Poa bulbosa*), Streaked Horned Lark use of disturbed vegetation in western Washington airports, and American Badger use of cheatgrass dominated communities of eastern Washington. The only terrestrial SGCN species identified as closely associated with Introduced and Semi-natural Vegetation is the Island Marble, a butterfly that inhabits the San Juan Islands associated with several introduced species that have spread in disturbed habitats, including field mustard (*Brassica campestris*), tall tumble mustard (*Sisymbrium altissimum*), and tall peppergrass (*Lepidium virginicum*).

Distribution	Public Land	Private Land	SGCN with close association (#)	SGCN with general association (#)	Ecological systems of concern (#)
1,085 mi ²	20%	80%	2	38	0

Major Stressors

Human disturbance is the key stressors for these systems, including changes in disturbance patterns and conversion to agricultural production.

Habitat needs for SGCN associated with this system

Short-stature exotic grasses and forbs	A number of SGCN that use Introduced and Semi-natural Vegetation are associated with short stature exotic grasses and forbs, essentially providing structural similarities to native habitats. These include Streaked Horned Lark, Burrowing Owl, Oregon Vesper Sparrow, and Sharp-tailed Grouse. Oregon spotted frogs only use reed canarygrass habitat to a significant degree when it is mowed annually.
Large unfragmented blocks of habitat	Many SGCN are area sensitive, meaning they have a minimum size threshold for habitat to be functional for uses such as for breeding. Bald Eagle, Peregrine Falcon, Oregon Vesper Sparrow, and Sharp-tailed Grouse are known to require larger contiguous patches of undeveloped land.

Actions needed to maintain habitat quality for SGCN

- Habitat Management - a number of SGCN that use Introduced and Semi-natural Vegetation are associated with a particular condition that may be subject to change over time, or a disturbance regime. Streaked Horned Lark, for example, is associated with short-stature vegetation at various airports in south Puget Sound. Airport habitat is actively mowed during the growing season to maintain the short-stature vegetation. Other disturbances like herbicide application, irrigation canal maintenance, and road maintenance have the potential to disrupt, disturb, or eliminate these species.
- Habitat Restoration – restoring native species to these environments can greatly increase their value to wildlife. Adding sagebrush to areas dominated by introduced grasses and forbs can provide a significant benefit to Sage-grouse, for example.

OPEN FRESHWATER SYSTEMS

Overview

Open freshwater systems take on a variety of forms, from streams and rivers, potholes and small beaver ponds, to large lakes and reservoirs. They are found in every corner of the state, in all climates, at almost all elevations, and are just as common in wilderness areas as they are in major urban centers. An interesting fact is that Washington has more streams than any state other than Alaska. It should be noted that freshwater wetlands and some other standing shallow waters are not classified as Open Water (see Freshwater and Wet Meadow and Marsh).

Open water stands out from all terrestrial and other freshwater systems in that they have significantly greater numbers of closely associated SGCN. That in part is because all freshwater and anadromous fish as well as other aquatic species rely on open water for at least part of their life history. However, a large number of terrestrial and semi-aquatic SGCN also have a close affinity to open waters. These include many amphibians, waterfowl, as well as species of bats that use open waters to forage on insects. Because open water systems support so many sensitive species, the influence that disturbances pose on SGCN is a serious one to the state's overall biodiversity. In fact, the consequences of numerous disturbances to open water systems are being felt right now. Those are reflected in the large number of aquatic species in Washington that are Federally Threatened and Endangered, such as the 16 Pacific salmon, steelhead and bull trout species units included as SGCN.

Distribution	Public Land	Private Land	SGCN with close association (#)	SGCN with general association (#)	Ecological systems of concern (#)
4,402 mi ²	87%	13%	67	22	0

Major Stressors

- Reduced glacial and snowpack runoff to replenish open water systems from climate change.
- More frequent and intense droughts lasting longer durations from climate change.
- Physical barriers to instream movement and migration.
- Altered water quality from (e.g., increased temperature, sediment, nutrients, and toxicants) from loss of riparian filtering, as well as urban and agricultural runoff.
- Physical alterations, like dredging, channelizing, damming, and confinement of migrating channels.
- Artificial modifications to hydrology from activities such as damming and irrigation.
- Loss of aquatic habitat complexity.
- Altered natural disturbance processes (e.g., seasonal flooding) and regimes.

Habitat needs for SGCN associated with this system

Good water quality	Many aquatic and semi-aquatic SGCN require waters that are clean and cold for their survival and fitness. These include many anadromous salmonids, freshwater fishes and amphibians.
Habitat complexity	A large number of SGCN require various types of aquatic habitat and diverse habitat structure. This includes areas with clean spawning gravels, large instream wood, deep pools, off-channel habitats (e.g., oxbows) and locations where species can find cool water refuge during periods of high stream temperatures.
Habitat connectivity	Connectivity is especially important to migratory anadromous fish where their life histories require being able to reach their particular spawning grounds. Lateral connectivity is also important between a stream's main stem and off-channel and floodplain habitats.

Actions needed to maintain habitat quality for SGCN

- Removal of artificial barriers, especially ones that can open up new habitat for SGCN.
- Research to assess influences of climate change and to identify mitigation measures.
- Maintaining function associated with intact riparian habitat.
- Maintenance and enhancements of in-stream structure (e.g., large downed wood) and complexity.
- Improve water quality (e.g., maintain or decommission roads causing siltation and erosion).
- Reintroduction and protection of beaver and conservation of beaver ponds.

RECENTLY DISTURBED OR MODIFIED

Overview

There are seven Recently Disturbed or Modified ecological systems in Washington. Three are represented by second-growth or recently deforested lands at various stages of regeneration. The others are characterized by recent fire disturbances. Either of these two groups can include places where the disturbance is the result of something other than human intervention, such as a stand of windblown timber. But in most cases the disturbance is human-caused (e.g., a catastrophic wildfire caused by a built-up fuels from fire suppression). In general, these areas are considerably altered from their historical condition, especially when the disturbance is directly caused by humans. Consequently they have lower ecological integrity when compared to their undisturbed counterparts and their value to native species has usually been compromised.

Although these lands may be less valuable, it is important not to undervalue or ignore them. One reason for this is that they comprise a large area, 10 percent of the state's land area in total. Because of this they are prominent across Washington's landscape and thus need to be seen for their potential. This includes their potential for habitat restoration as well as their potential to provide other benefits (e.g., as connections between important habitat areas). Although their value to native species is compromised, many recently disturbed or modified areas provide habitat to SGCN. In fact, 68 SGCN are associated with these systems, many of which are habitat generalists, though some have a particular affinity to the disturbed nature of these systems. Five of these SGCN are closely associated with these modified systems.

Distribution	Public Land	Private Land	SGCN with close association (#)	SGCN with general association (#)	Ecological systems of concern (#)
6,649 mi ²	38%	62%	5	63	0

Major Stressors

- Altered natural disturbance regimes and processes.
- Loss of structural diversity and habitat complexity.
- Loss of older forests because of short harvest rotation cycles.
- Spread of invasive plants.
- Habitat fragmentation and loss of connectivity.

Habitat needs for SGCN associated with this system

Complex habitat structure	Many SGCN associated with disturbed habitats prefer the presence of more complex habitat features such as snags and downed wood, and multiple canopy layers. The SGCN that have an affinity for more complex conditions are Barrow's Goldeneye, Great Gray Owl, Lewis' Woodpecker, Northern Spotted Owl, Western Bluebird, Keen's Myotis, and Silver-haired Bat.
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Protect key habitats within area of disturbance	Within disturbed areas some types of habitats deserve special attention because of their value to many SGCN. These include systems such wetlands and riparian areas.
Climax condition	Several species prefer more mature habitat conditions or habitats that have at least some characteristics of climax conditions, like large trees. The SGCN that have an affinity for these conditions are Cascade Torrent Salamander, Bald Eagle, Barrow's Goldeneye, Great Gray Owl, Northern Spotted Owl, Keen's Myotis, and Western Gray Squirrel.
Open habitat	Some SGCN prefer open habitat over those with closed understories. These are Loggerhead Shrike, Short-eared Owl, Streaked Horned Lark, White-headed Woodpecker, and American Badger.

Actions needed to maintain habitat quality for SGCN

- Controlling the spread and removal of invasive plants.
- Controlled burns and forest thinning to reduce the possibility of large wildfire.
- Habitat restoration.
- Prioritization of disturbed and modified sites and landscapes for conservation and protection.

SALT MARSH VEGETATION

Overview

Salt Marsh vegetation includes three ecological systems; Inter-Mountain Basins Playa and Alkaline Closed Depression, Greasewood Flat, Tidal Salt/ Brackish Marsh. The Alkaline Closed Depression Ecological Systems are sparsely to densely vegetated found on seasonally flooded sites over saline soils in closed depressions or terminal basins. The Greasewood Flat ecological system includes open to moderately dense shrublands dominated or codominated by Greasewood (*Sarcobatus vermiculatus*) and also with saline soils. Inter-Mountain Basins Playa and Alkaline Closed Depression and Inter-Mountain Basins Greasewood Flat ecological systems are found in central to southern eastern Washington. The Tidal/Brackish Marsh ecological system is associated with tidally influenced coastal wetlands of estuaries, lagoons, and bays, and behind sand spits. All three of these ecological systems are ecological systems of concern.

Climate changes that lead to changes in water levels may impact inter-mountain basins playa, alkaline closed depressions and greasewood flats. Changes in precipitation may lead to fluctuations in salinity levels, which could lead to shifts in vegetation composition. Increases in runoff that increase nutrient levels in basin playas and alkaline closed depressions could also threaten vegetation. Projected sea level rise represents a key climate stressor for tidal salt and brackish marshes, as it could lead to submergence of habitats and declines in vegetation unless they are able to migrate inwards through sediment accretion.

Distribution	Public Land	Private Land	SGCN with close association (#)	SGCN with general association (#)	Ecological systems of concern (#)
91 mi ²	61%	39%	3	25	3

Major Stressors

Habitat degradation and exotic plant invasions, Development (dredging, filling, channeling), hydrological alteration and climate change.

Habitat needs for SGCN associated with this system

High invertebrate diversity/abundance	Invertebrates serve as food for many of these species, including Marbled Godwit, Harlequin Duck, Red-necked Grebe, Surf Scoter
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Actions needed to maintain habitat quality for SGCN

- Fire management (establishment of natural fire regimes and prescribed fire),
- Grazing, Agriculture, and farm management,
- Invasive species control,
- Habitat restoration, research, and native species restoration, including hydrological restoration.

Ecological systems discussed in greater detail in this chapter

Of the 12 ecological systems found in this formation, the following 3 are discussed in greater detail here. These are considered ecological systems of concern, either because of their imperiled conservation status, because of their importance to SGCN, or both.

- A. Inter-Mountain basins Greasewood Flat
- B. Inter-Mountain Basins Playa and Alkaline Closed Depression
- C. Temperate Pacific Tidal Salt/Brackish Marsh

Inter-Mountain Basins Greasewood Flat

Conservation Status and Concern

This is a geographically limited ecological system with small sites. The primary conservation concern is degradation of the system.

Description and Distribution

Greasewood flats are limited to the Columbia Basin, especially the northern and central portions of the basin. They often co-occur with playas and alkaline depressions. They are more common in Benton, Grant, Franklin, Klickitat, and Walla Walla Counties.

Soils are typically saline and bare ground is a common feature. The water table remains high enough to maintain vegetation, despite salt accumulations. Wetland vegetation may concentrate near seeps/springs or in drainages where standing water is perennial. Saline soils and dominance by greasewood distinguish this type from other ecological systems. The primary ecological process maintaining greasewood flat systems is an elevated groundwater table.

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
None	S1	Critically imperiled/ declining. Decline of 30-50% within the last 50 years and from historical conditions.	MAMMALS : American Badger, Black-tailed Jackrabbit, Hoary Bat, Pygmy Rabbit, Silver-haired Bat, Spotted Bat, Townsend's Big-eared Bat BIRDS : Golden eagle, Loggerhead Shrike, Peregrine Falcon, Short-eared Owl

* No species were identified with a close association

Stressors and Actions Needed

The primary stressors are alteration of hydrology, livestock practices, annual exotic species invasion, fire regime alteration, and fragmentation. Activities resulting in hydrological alterations, sedimentation, nutrient inputs, and/or physical disturbance may negatively shift species composition and allow for non-native species establishment. Declining water tables create perennially dry soils, stop surface salt accumulation, and allow salts to leach deeper that create a drier, less saline soil resulting in a change in vegetation composition and pattern. The tall perennial Pepperwood (*Lepidium latifolium*), a nonnative invasive species decreases the abundance of shorter native grasses and forbs. The introduction of cheatgrass into these communities has altered fuel loads and fuel distribution. Fire alters the community composition because salt-desert shrubs are not adapted to periodic fire.

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Alteration of hydrology	Hydrological alterations, agriculture, roads, and development	<ul style="list-style-type: none"> Land acquisition Private lands agreements 	Identify and protect sites with good ecological integrity.
Invasive and other problematic species	Invasive species increase with excessive grazing, trampling	<ul style="list-style-type: none"> Grazing/farm management Invasive species control 	Mechanical and herbicide control of exotics, planning

Inter-Mountain Basins Playa and Alkaline Closed Depression

Conservation Status and Concern

A significant amount of this system has been lost due to alterations of hydrology. Degradation has occurred across its range and in most locations. There are two SGCN that are considered closely associated with this ecological system and 12 that are considered generally associated with this ecological system (see table below).

Description and Distribution

The Inter-Mountain Basins Playa and the Inter-Mountain Basins Alkali Closed Depression Ecological Systems occur throughout much of the cool arid and semi-arid regions of the Columbia Plateau and Great Basin. They almost always appear within a shrub steppe or semi-desert landscape. They are differentiated by 1) vegetation cover (playa is typically sparse to patchily vegetated, generally less than 10 percent plant cover while alkali closed depression is moderately to densely covered by herbaceous plants), 2) soil chemistry (playas are considered more saline than alkaline closed depressions), and 3) hydrological regime (playas are more intermittently flooded; closed depressions are more seasonally to semi-permanently flooded).

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes Freshwater Wetlands	S1	Critically Imperiled/ declining. Declines of 30-50% within the last 50 years and from historical conditions.	MAMMALS: Hoary Bat, Kincaid's Meadow Vole, Silver-Haired Bat, Spotted Bat, Townsends Big-Eared Bat. BIRDS: American White Pelican, Bald Eagle, Barrows Goldeneye, Cinnamon Teal*, Golden Eagle, Loggerhead Shrike, Marbled Godwit, Peregrine Falcon*, Short-eared Owl.

* SGCN is closely associated with this ecological system

Key Stressors and Actions Needed

Historical and current land use practices have impacted hydrologic, geomorphic, and biotic structure and function of playas on the Columbia Basin. Reservoirs, water diversions, ditches, roads, and human land uses in the contributing watershed can also have a substantial impact on the hydrological regime. Direct alteration of hydrology (i.e., channeling, draining, damming) or indirect alteration (i.e., roads or removing vegetation on adjacent slopes) results in changes in the amount and pattern of herbaceous wetland habitat. Excessive livestock grazing leads to a shift in plant species composition.

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Alteration of hydrology	Hydrological alterations associated with agriculture, roads, and development	<ul style="list-style-type: none"> Land acquisition Private lands agreements Water management 	Identify and protect sites with good ecological integrity.

Invasive and other problematic species	Invasive species increase with excessive grazing, trampling	<ul style="list-style-type: none"> Grazing/farm management Invasive species control 	Mechanical and herbicide control of exotics, planning
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Temperate Pacific Tidal Salt and Brackish Marsh

Conservation Status and Concern

A significant amount of this system has been lost. Habitat degradation has occurred across its range and in most locations. There is one terrestrial SGCN that is considered closely associated with this ecological system, and 15 terrestrial species considered generally associated with this ecological system. A complete analysis of habitat association has not been done for SGCN fishes.

Description and Distribution

Temperate Pacific Tidal Salt and Brackish Marsh Ecological Systems are found along the Pacific Coast, from south-central Alaska to the central California coast. In Washington, it occurs in large bays on the outer coast and around the waters of Puget Sound. Occurrences are confined primarily to inter-tidal portions of estuaries, coastal lagoons and bays, and behind sand spits or other locations protected from wave action. Their associated specific environments are defined by ranges of salinity, tidal inundation regime, and soil texture. This system is characterized as being dominated by emergent vegetation whose composition is influenced by tidal fluctuations and varying degree of salinity (saline to brackish). Marine salt water circulation through a marsh is most important factor in marsh plant species distribution.

Characteristic plant species include seashore salt grass (*Distichlis spicata*), sea milkwort (*Glaux maritima*), jaumea (*Jaumea carnosa*), pickleweed (*Salicornia* spp.), sea blight (*Suaeda* spp.), and arrow grass (*Triglochin* spp.).

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes	S2	Imperiled/declining	MAMMALS : Shaw Island Vole
Nearshore – coastal			BIRDS : Bald Eagle, Barrow's Goldeneye, Black Scoter, Brown Pelican, Common Loon, Dusky Canada Goose, Harlequin Duck, Marbled Godwit, Peregrine Falcon, Purple Martin, Red-necked Grebe, Surf Scoter, White-winged Scoter, and Western High Arctic Brant
Nearshore – Puget Sound		Declines of 50-70% within the last 50 years and from historical conditions.	FISH : to be determined- research needed
			INVERTEBRATES : Island Marble*

* SGCN is closely associated with this ecological system

Stressors and Actions Needed

A number of stressors related to development, transportation and agriculture contribute threats to this ecological system.

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Alteration of hydrology	Hydrological alterations, agriculture, roads, and development	<ul style="list-style-type: none"> Planting/seeding Vegetation management Water management 	Salt marsh restoration, including restoration of native species
Invasive and other problematic species	Invasive species such as spartina	<ul style="list-style-type: none"> Invasive species control 	Mechanical and herbicide control of exotics

SCRUB AND HERBACEOUS COASTAL VEGETATION

Overview

Scrub and herbaceous coastal vegetation includes two ecological systems, North Pacific Coastal Cliff and Bluff, and Coastal Sand Dune and Strand. The North Pacific Coastal Cliff and Bluff includes un-vegetated or sparsely vegetated rock cliffs and very steep bluffs along Washington's coastline and associated marine and estuarine inlets. Sand dunes are isolated and scattered in Puget Sound, and most abundant along the southern Washington coastline.

Distribution	Public Land	Private Land	SGCN with close association (#)	SGCN with general association (#)	Ecological systems of concern (#)
28 mi ²	49%	51%	12	4	1

Major Stressors

1. Invasive species
2. Habitat degradation
3. Recreation
4. Climate Change

Currently, the major threats to Scrub and Herbaceous Coastal Vegetation is the continued spread and subsequent stabilization of sand dunes by invasive species, off road vehicle use, road construction, intentional dune stabilization, and conversion to residential lots. The exotic European beachgrass (*Ammophila arenaria*) has been extensively planted for stabilization purposes and has also spread widely on its own for over 125 years and the eastern North American native American beachgrass (*A. breviligulata*) has been planted and spreading on the Long Beach peninsula. Once these plant species became established, the physical form and natural processes of dunes were altered, leading to rapid acceleration of successional processes, which then altered the native species composition.

Sea level rise, increased coastal erosion, and increased storminess and wave action represent significant climate stressors for this formation. Projected sea level rise could cause erosion and/or landward shift of dunes and cliffs. Similarly, greater wave and wind action from storms could cause increased disturbance and erosion of cliffs, dunes, and dune vegetation. Climate induced-changes or declines in dune vegetation that help stabilize and protect dunes could make dune habitat more vulnerable to disturbances from increased erosion, waves, and winds.

Habitat needs for SGCN associated with coastal sand dune and strand

High ecological integrity	Some of the birds (Streaked Horned Lark, Snowy Plover) and invertebrates (Taylor's Checkerspot, Sand Verbena Moth, Oregon Silverspot, Acmon Blue) require either an open dune composition without exotic beachgrasses, or short-stature vegetation provided by native species, and are sensitive to invasive weeds including dunegrasses.
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Actions needed to maintain habitat quality for SGCN

- Habitat restoration, research, and native species restoration.
- Invasive species control,
- Manage public recreation, including off road vehicle use.

Ecological systems discussed in greater detail:

Of the 2 ecological systems found in this formation, North Pacific Coastal Sand Dune and Strand is discussed in greater detail here. It is considered an ecological system of concern because of its imperiled conservation status and because of its importance to SGCN.

North Pacific Maritime Coastal Sand Dune and Strand

Conservation Status and Concern

This ecological system is located in active or stabilized dunes along the coast. Exotic species like American beachgrass have greatly reduced or eliminated active dune processes, helping to accelerate successional process, greatly increasing vegetative cover, and restricting habitat for species associated with this ecological system. There are eight Species of Greatest Conservation Need that closely associated with this ecological system.

Description and Distribution

Sand dunes are distributed along the Pacific coast from south-central Alaska to central Oregon. In Washington dunes are found locally in Puget Sound, coastlines along the Straits of Juan de Fuca, and the western Olympic Peninsula. The most extensive areas of sand dunes are in the southern portion of the Washington coast between the mouths of the Copalis and Columbia Rivers. Coastal dunes include beach strand (not the beach itself but sparsely or densely vegetated areas behind the beach), foredunes, sand spits, and active to stable backdunes and sandsheets. Coastal dunes often front portions of inlets and tidal marshes. Significant plant species include native grasses such as dunegrass (*Leymus mollis*) and red fescue (*Festuca rubra*).

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes	S1	Imperiled/ declining	MAMMALS: Shaw Island Vole
Nearshore – coastal		Decline of 50-70% within the last 50 years.	BIRDS: Streaked Horned Lark*, Snowy Plover*, Bald Eagle, and Peregrine Falcon.
Nearshore – Open Water		Decline of 70-80% from historical conditions.	INVERTEBRATES: Sand Verbena Moth*, Oregon Silverspot Butterfly, Taylor's Checkerspot*, Acmon Blue*, Island Marble*, and Siuslaw Sand Tiger Beetle*.
Nearshore – Puget Sound			

* SGCN is closely associated with this ecological system

Stressors and Actions Needed

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Fish and wildlife habitat loss or degradation	Dune stabilization has resulted in accelerated succession, invasion of exotic trees, shrubs and grasses, and reduction or loss of function of critical habitat	<ul style="list-style-type: none"> Vegetation management 	Integrated habitat restoration using weed control and seeding with natives
Invasive and other problematic species	Invasive forbs and shrubs are degrading native vegetation	<ul style="list-style-type: none"> Invasive species control 	Mechanical and herbicide control of exotics
Recreation	Off-road vehicle use has resulted in the loss of native communities	<ul style="list-style-type: none"> Land acquisition Private lands agreements 	Identification and protection of areas with high ecological integrity

SEMI-DESERT SCRUB AND GRASSLAND

Overview

Semi-Desert Scrub and Grasslands includes nine verified ecological systems in Washington. Comprised of native upland vegetation, these systems occur throughout most of eastern Washington. The underlying soils are variable across the spectrum, although some systems are strongly linked to a particular soil characteristic (e.g., deep soil systems). All Semi-Desert Scrub and Grassland systems in Washington have an understory layer typically made up of native bunchgrasses that are almost always accompanied by other perennial grasses and/or forbs. Although not all the systems have a shrub layer, most have some cover of shrubs. Dominant shrubs include big sagebrush (*Artemisia tridentata*), antelope bitterbrush (*Purshia tridentata*), rabbitbrush (*Chrysothamnus* spp.), and dwarf sagebrush (*Artemisia arbuscula*). At the soil surface, diverse communities of moss and lichen can also be found, especially if soils are relatively intact or undisturbed. A total of 22 SGCN are closely associated with Semi-Desert Scrub and Grassland systems, and 44 SGCN are generally associated.

Distribution	Public Land	Private Land	SGCN with close association (#)	SGCN with general association (#)	Ecological systems of concern (#)
7,729 mi ²	46%	54%	22	44	4

Major Stressors

- Agriculture conversion
- Wind power and residential development
- Soil disturbance
- Invasive annual plants.
- Fire and fire frequency
- Excessive grazing

Climate changes including shifts in precipitation, drought, and altered fire regimes may affect plant composition, density, and distribution in semi-desert scrub and grassland habitats. Precipitation likely influences plant composition, growth, and recruitment, and drought negatively affects seedling survival in sagebrush systems, reduces shrub cover, and elevates herbaceous diversity and cover. Increasing fire frequencies and/or intensities will likely negatively affect sagebrush and shrub habitats, and may favor grassland expansion. However, fire also favors cheatgrass and other non-native annual establishment, which can alter ecosystem function.

Habitat needs for SGCN associated with this system

Deep Soils	Several species, American Badger, Pygmy Rabbit, Washington Ground Squirrel, and Burrowing Owl require relatively deep soils suitable for burrowing. The burrowing actions of some of these species also function to provide natural disturbance in grassland habitats.
Minimal habitat fragmentation	Greater Sage-grouse, Sage Thrasher, and Sagebrush Sparrow require large intact blocks of shrub-steppe habitat.

High ecological integrity	Many SGCN that use ecological systems associated with Semi-Desert Scrub and Grassland do best where native perennial plants such as bunchgrasses are dominant and where the fire return interval is low. Some SGCN also have highly specific preferences in terms of habitat structure. Ecological integrity of this habitat's riparian areas is important for SGCN interior Columbia basin anadromous salmonids and freshwater fishes.
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Actions needed to maintain habitat quality for SGCN

- Management to maintain infrequent intervals of fire,
- Grazing management,
- Invasive species control (cheatgrass in particular),
- Habitat and native species restoration.

Research and Data Needs

- Research to help improve techniques for restoring degraded habitat.
- Studies to help develop science-based compensatory mitigation ratios.

Ecological systems and other habitats discussed in greater detail in this chapter include:

- A. Columbia Plateau Low Sagebrush Steppe
- B. Inter-Mountain Basins Big Sagebrush Steppe
- C. Inter-Mountain Basins Semi-Desert Shrub Steppe
- D. Columbia Plateau Steppe and Grassland

Columbia Plateau Low Sagebrush Steppe

Conservation Status and Concern

This ecological system is very rare, occupying less than one percent of Washington's land area. The ecological integrity of the system is in decline, primarily due to disturbances from intense grazing and invasive plants. Fifteen terrestrial SGCN are associated with this system and two of those are closely associated.

Description and Distribution

This large patch system occurs on isolated ridges at or above the lower treeline (approximately 3300 to 4500 feet) within the East Cascade, Blue Mountain, and Columbia Plateau Ecoregions. The system often lies adjacent to Douglas-fir and ponderosa pine forests. While the overstory canopy is dominated by dwarf sagebrush understory vegetation is made up of bunchgrasses and/or native forbs. Although bunchgrasses typically dominate, forbs can be dominant, especially at higher elevations. The space between vascular plants may support a crust of mosses and lichens, especially where soils are relatively undisturbed and intact. Substrates are shallow, fine-textured soils or poorly drained clays, and are almost always very stony.

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes Shrub-steppe	S2	Imperiled/declining >30% decline within the last 50 years. Decline from historical conditions is unknown.	MAMMALS: American Badger, Black-tailed Jackrabbit, Hoary Bat, Merriam's Shrew, Silver-haired Bat, Spotted Bat, Townsend's Big-eared Bat, White-tailed Jackrabbit
			BIRDS: Golden Eagle, Greater Sage-grouse*, Loggerhead Shrike, Mountain Quail, Short-eared Owl
			REPTILES/AMPHIBIANS: Short-horned Lizard*
			FISH: to be determined- research needed
			INVERTEBRATES: Morrison's Bumblebee

* SGCN is closely associated with this ecological system

Stressors and Actions Needed

Disturbance from grazing and from the spread of invasive plants seem to be the chief threats to this system. On some sites cheatgrass has replaced native perennials. This is especially true on sites that are intensely grazed. Intense grazing also reduces the cover of moss and lichens and increases patches of bare ground. Areas of bare ground are highly susceptible to cheatgrass invasion.

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Invasive and other problematic species	Invasive annual grasses (cheatgrass) and exotic weeds have degraded habitat. In other places the problem is an overabundant cover of native shrubs.	<ul style="list-style-type: none"> Invasive species control 	Mechanical and herbicide control of invasive species.

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Fish and wildlife habitat loss or degradation	Habitat has been lost to agriculture, and development to a lesser degree.	<ul style="list-style-type: none"> • Environmental Review • Land acquisition • Land use planning • Private lands agreements 	Acquisitions, conservation easements, landowner agreements, and restoration.

Columbia Plateau Steppe and Grassland

Conservation Status and Concern

Historically this system was more expansive across eastern Washington. Much of that expanse has been converted, especially to croplands. What is left is mostly degraded by grazing, an altered fire regime, invasive plants, and various other disturbances. Thirty-two terrestrial SGCN are associated with this system and nine of those are closely associated.

Description and Distribution

This extensive grassland system is dominated by perennial bunchgrasses and forbs (greater than 25 percent cover) and sometimes a sparse canopy of shrubs (less than 10 percent cover). Soils are variable, ranging from relatively deep to stony volcanic-derived clays, to alluvial sands. A characteristic of the soils is that often they lack areas of exposed or bare soil. Instead they typically are carpeted by a crust of mosses and lichens, especially where soils are intact and relatively undisturbed. In contrast to closely related ecological systems, historical fire frequency is higher, which is a factor for its low cover of fire intolerant shrubs. In Washington this large patch system is widespread throughout the Columbia Plateau Ecoregion, though it also occurs in small segments of the Blue Mountain, Okanogan, and East Cascade Ecoregions.

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes Eastside Steppe	S2	Imperiled/ declining	MAMMALS: American Badger*, Black-tailed Jackrabbit, Hoary Bat, Merriam's Shrew, Silver-haired Bat, Spotted Bat, Townsend's Big-eared Bat, Townsend's Ground Squirrel, Washington Ground Squirrel, White-tailed Jackrabbit
			BIRDS: Burrowing Owl, Cinnamon Teal, Ferruginous Hawk*, Golden Eagle, Greater Sage Grouse*, Loggerhead Shrike, Mountain Quail, Sage Thrasher*, Sagebrush Sparrow, Sharp-tailed Grouse*, Short-eared Owl
			REPTILES/AMPHIBIANS: Columbia Spotted Frog, Northern Leopard Frog*, Tiger Salamander, Woodhouse's Toad*, Night Snake, Ringneck Snake*, Short-horned Lizard*, Side-blotched Lizard
			FISH: to be determined- research needed
			INVERTEBRATES: Morrison's Bumblebee, Hoder's Mountainsnail, Ranne's Mountainsnail

* SGCN is closely associated with this ecological system

Stressors and Actions Needed

The ecological integrity of this system has been diminished by persistent grazing, cropland conversion, invasive plants, altered fire regime, soil disturbance, and habitat fragmentation. Most deep soils steppe and grasslands has been converted to croplands. Thus most of what remains is on shallow, rocky soils. Although cropland conversion rates are not nearly what they were at their peak, conversions to agriculture still take place, especially in the wine-producing southern Columbia Valley. Residential and wind farm development is another source of direct loss of this habitat. And much of what has not already been converted is degraded. Fire suppression throughout much of the range has degraded the system by increasing shrub cover. These shrubs have displaced bunchgrasses and forbs by outcompeting with them for space and light. Grazing practices incompatible with habitat conservation have also degraded a considerable amount of this habitat. Where grazing is heavy and persistent the system responds in various ways depending on the type of grazing and season. In general, overgrazing has spread invasive plants, decreased native perennial cover, compacted soils, eliminated soil crusts of mosses and lichens, and has increased shrub cover. Across much of this landscape grazing and other land uses have increased bare ground and have replaced native perennials with cheatgrass. Fire on livestock-altered vegetation has further promoted the spread of annuals.

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Altered disturbance regimes	An altered fire regime and ground disturbance has degraded the habitat and has led to a loss of habitat diversity. Fire has a particularly strong impact to indigenous shrub and bunchgrass communities.	<ul style="list-style-type: none">• Fire management• Vegetation management• Grazing /farm management• Invasive species control	Integrated habitat restoration using prescribed fire, weed control, and seeding with native vegetation.
Fish and wildlife habitat loss or degradation	Habitat has been lost to agriculture and the development of homes and wind farms.	<ul style="list-style-type: none">• Environmental Review• Land acquisition• Land use planning• Private lands agreements	Acquisitions, conservation easements, landowner agreements, and restoration.
Invasive and other problematic species	Invasive annual grasses (cheatgrass) and exotic weeds have degraded habitat. In other places the problem is an overabundant cover of native shrubs.	<ul style="list-style-type: none">• Invasive species control	Mechanical and herbicide control of invasive species.

Inter-Mountain Basins Big Sagebrush Steppe

Conservation Status and Concern

Historically this system was more expansive across eastern Washington. Much of that expanse has been converted, especially to croplands. What is left is mostly degraded by grazing, an altered fire regime, invasive plants, and various other disturbances. Twenty-five terrestrial SGCN are associated with this system and nine of those are closely associated.

Description and Distribution

This large patch system occurs throughout a large portion of the Columbia Plateau and Okanogan Ecoregions, as well as the lower foothills of the East Cascade Ecoregion. When found in less disturbed conditions it takes the character of a grassland with a conspicuous, but discontinuous, layer of shrubs. The natural fire regime of this ecological system historically maintained this patchy distribution of shrubs. The characteristic shrubs, typically sagebrush (*Artemisia* spp.) and/or antelope bitterbrush, form an open to moderately dense shrub layer (5 to 40 percent cover). Ground cover typically is made up of moderate to dense layer (more than 25 percent cover) of perennial bunchgrasses, although native forbs are also common to the herbaceous layer of this system. Soils are typically deep and non-saline, and typically are encrusted on the surface by mosses and lichens that bind the soil surface (biological soil crust), especially when soils are undisturbed. This system differs from the similar Inter-Mountain Basins Montane Sagebrush Steppe in that it occurs at lower elevations, mainly below 3,000 feet.

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes Shrub- steppe	S2	Imperiled/ declining Decline of 30-50% within the last 50 years and from historical conditions.	MAMMALS: American Badger*, Black-tailed Jackrabbit, Hoary Bat, Merriam's Shrew, Pygmy Rabbit*, Silver-haired Bat, Spotted Bat, Townsend's Big-eared Bat, Townsend's Ground Squirrel, Washington Ground Squirrel, White-tailed Jackrabbit
			BIRDS: Burrowing Owl*, Cinnamon Teal, Ferruginous Hawk*, Golden Eagle, Greater Sage-Grouse*, Loggerhead Shrike, Mountain Quail, Peregrine Falcon, Sage Thrasher*, Sagebrush Sparrow*, Sharp-tailed Grouse*, Short-eared Owl
			REPTILES/AMPHIBIANS: Northern Leopard Frog*, Tiger Salamander, Western Toad, Woodhouse's Toad*, Night Snake, Ringneck Snake*, Sagebrush Lizard*, Sharptail Snake*, Short-horned Lizard*, Side-Blotched Lizard, Striped Whipsnake*
			FISH: to be determined- research needed
			INVERTEBRATES: Morrison's Bumblebee, Columbia Oregonian, Poplar Oregonian, Hoder's Mountainsnail, Ranne's Mountainsnail, Limestone Point Mountainsnail

* SGCN is closely associated with this ecological system

Stressors and Actions Needed

Because this system lies on deep, fertile soils, it has been targeted for its suitability as cropland. Consequently, much of this system has been converted to crops, especially in the Columbia Basin Reclamation area. Cropland conversions have made deep soil Big Sagebrush Steppe rare. Although rates of cropland conversion are not nearly what they were at their peak, agriculture conversions still occur like in the wine-producing southern Columbia Valley. Residential and wind farm development is another source of direct loss of this habitat. Grazing is another ongoing disturbance, especially when grazing practices are incompatible with habitat conservation. Where grazing is heavy and persistent the system responds in various ways depending on the type of grazing and season. In general, overgrazing spreads invasive plants, compacts soils, eliminates important soil crusts of mosses and lichens, and can lead to a dense shrub cover. Dense shrub cover can in turn compete with native bunchgrasses for very limited water, reducing their cover. Shrubs also increase following fire suppression. Frequent intense fires, on the other hand, can eliminate entire stands of sagebrush. Recovery to pre-fire shrub cover can then take decades, especially in low rainfall areas.. After wildfire, conditions become favorable for the spread of annuals, such as cheatgrass, which make sites more susceptible to subsequent wildfire. All these changes in shrub-steppe composition and structure ultimately reduce the habitat conditions required for many SGCN to persist.

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Altered disturbance regimes	Fire and ground disturbance has degraded the habitat and has led to a loss of habitat diversity. Fire has a particularly strong impact to indigenous shrub and bunchgrass communities.	<ul style="list-style-type: none">• Fire management• Vegetation management• Grazing /farm management	Integrated habitat restoration using prescribed fire, weed control, and seeding with native vegetation.
Fish and wildlife habitat loss or degradation	Habitat has been lost to agriculture and the development of homes and wind farms.	<ul style="list-style-type: none">• Environmental Review• Land acquisition• Land use planning• Private lands agreements	Acquisitions, conservation easements, landowner agreements, and restoration.
Invasive and other problematic species	Invasive annual grasses (cheatgrass) and exotic weeds have degraded habitat. In other places the problem is an overabundant cover of native shrubs.	<ul style="list-style-type: none">• Invasive species control	Mechanical and herbicide control of invasive species.

Inter-Mountain Basins Semi-Desert Shrub Steppe

Conservation Status and Concern

This is the rarest of all Semi-Desert Scrub and Grassland ecological systems in Washington, occupying roughly a tenth of one percent of Washington's land area. Being in the driest region of Washington, this shrub-steppe ecosystem is particularly vulnerable to the spread of invasive plants that often are facilitated by fire and grazing. Six terrestrial SGCN are associated with this system and the Ferruginous Hawk is the only close associate.

Description and Distribution

Inter-Mountain Basins Semi-Desert Shrub Steppe occurs in the hottest and driest parts of southeastern Washington's Columbia Plateau, where annual rainfall is less than 8 inches. Although some occurrences are on public lands, most is in private ownership. Patch sizes of this ecological system range from small to large. Though the canopy often consists of an open to moderately dense mix of shrubs and dwarf shrubs, some occurrences are dominated by a single species of shrub. Dominant shrubs include spiny hopsage (*Grayia spinosa*), winterfat (*Krascheninnikovia lanata*), and rubber rabbitbrush (*Ericameria nauseosa*). Native herbaceous cover in the understory typically exceeds 25 percent and principally is made up of bunchgrasses with few or no forbs. The natural fire regime is important to maintaining a patchy distribution of shrubs, which is a characteristic of this system. The result is that the general look tends to be more like a grassland than shrubland.

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes Shrub- steppe	S1	Imperiled/ declining 50-70% decline within the last 50 years and from historical conditions.	BIRDS: Ferruginous Hawk*, Golden Eagle, Loggerhead Shrike, Short-eared Owl, Cinnamon Teal
			FISH: to be determined- research needed
			INVERTEBRATES: Morrison's Bumble Bee

* SGCN is closely associated with this ecological system

Stressors and Actions Needed

This system's ecological integrity has been altered by persistent grazing, invasive plants, wildfire, soil disturbances, and habitat fragmentation. Grazing practices incompatible with habitat conservation have stressed the system by disturbing the delicate soils and by exposing bare ground. It also disturbs the layer of moss and lichens that lock in scarce amounts of soil moisture. Grazing has brought about a shift in this system's plant composition by creating dense stands of big sagebrush and by shifting the dominant grasses from native perennials to annuals, particularly cheatgrass. Because cheatgrass produces abundant fine fuels, its spread increases fire risk. Because fire also enhances the spread of cheatgrass, the system has become highly vulnerable to a persistent cycle of wildfire and cheatgrass expansion.

Fire has also drastically altered shrub species composition given the indigenous shrubs generally are intolerant of frequent fires. Although not as big a problem as grazing, wildfire, or invasive plants,

cropland expansion (especially where the soils are deeper) and development have fragmented some of this shrub-steppe.

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Altered disturbance regimes	Fire and ground disturbance has degraded the habitat and has led to a loss of habitat diversity. Fire has a particularly strong impact to indigenous shrubs.	<ul style="list-style-type: none"> • Fire management • Vegetation management • Grazing/farmmanagement 	Integrated habitat restoration using prescribed fire, weed control, and seeding with native vegetation.
Fish and wildlife habitat loss or degradation	Habitat has been lost to agriculture, and development to a lesser degree.	<ul style="list-style-type: none"> • Environmental Review • Land acquisition • Land use planning • Private lands agreements 	Acquisitions, conservation easements, landowner agreements, and restoration.
Invasive and other problematic species	Invasive annual grasses (cheatgrass) and exotic weeds have degraded habitat and increase with fire.	<ul style="list-style-type: none"> • Invasive species control 	Mechanical and herbicide control of invasive vegetation.

TEMPERATE FOREST

Overview

Temperate Forest includes 29 ecological systems comprised of native upland vegetation throughout a broad elevation range and wide distribution in Washington. Forests in this category vary from the dry forest types of the eastern Cascade Range to the rain forests along the Washington coast. Temperate Forests support numerous SCGN including the following species: 20 birds, 11 amphibians, 30 invertebrates, 24 mammals, 6 reptiles, and approximately 31 anadromous or freshwater fishes.

Distribution	Public Land	Private Land	SGCN with close association (#)	SGCN with general association (#)	Ecological systems of concern (#)
28,929 mi ²	70%	30%	66	55	8

Major stressors

1. Agricultural conversion in lower elevation areas
2. Conversion for development purposes
3. Intensive plantation forestry primarily in lower- and mid-elevation areas
4. Altered fire behavior in dry forest landscapes
5. Excessive grazing
6. Weed invasions
7. Climate change

Habitat needs for SCGN associated with this vegetation formation

Old-growth Forest - High Ecological Integrity	Old growth forest comprised of trees of a wide range of age, height and diameter distributions of living and dead trees which results in complex structure important to numerous species. Examples: Northern Spotted Owl nesting, roosting, and foraging habitat; Bald Eagle nesting and roosting habitat. Golden Eagle nesting in large ponderosa pines, White-headed Woodpecker foraging and nesting in ponderosa pine forests.
High microclimate diversity	Many of the butterflies use habitat of high microclimate diversity with few invasive plants and high diversity of native plants.
Snags and downed wood	Vertical structure and structure on the forest floor provide area for foraging wildlife such as woodpeckers and habitat for flying squirrels, an important prey species for Northern Spotted owl.

Actions needed to maintain habitat quality for SCGN

- Fire management (establishment of natural fire regimes)
- Establish longer forestry rotations
- Grazing management
- Invasive species control
- Habitat restoration, research, and native species restoration.
- Landowner agreements/incentives; acquisition/easements

Role of Climate Change

Increasing temperatures, decreased moisture availability, and altered fire regimes represent the most significant climate stressors to temperate forests. Altered fire regimes appear to be the greatest threat, particularly given fire suppression practices of the past century that have led to the invasion of shade-tolerant and fire-intolerant species and/or altered forest structure and composition (i.e., increased stand density, smaller diameter trees). Warmer temperatures and decreased moisture availability may increase insect outbreaks in some temperate forests. In general, North Pacific temperate forests likely exhibit less vulnerability to climate change than temperate forests of the East Cascades and Rocky Mountains.

Research and Data Needs

- Assess effectiveness of various restoration methods
- Assess ecological consequences of using silvicultural versus prescribed fire methods to restore and/or retain habitats (e.g. ponderosa pine forest and woodland).
- What is the range of ecological value (e.g. wildlife species occurrence) that might be expected to occur in these ecological systems depending on varying levels of anticipated or hypothesized protection or ecological restoration?
- Are there minimum patch sizes or levels of isolation that make patches usable or unusable for the SGCN that are closely associated?

Ecological systems and other habitats discussed in greater detail in this chapter include:

- A. East Cascades Oak-Ponderosa Pine Forest and Woodland
- B. North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland
- C. North Pacific Hypermaritime Sitka Spruce Forest
- D. North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest
- E. North Pacific Oak Woodland
- F. Northern Rocky Mountain Ponderosa Pine Woodland and Savanna.
- G. Northern Rocky Mountain Western Larch Savanna
- H. Rocky Mountain Aspen Forest and Woodland

East Cascades Oak-Ponderosa Pine Forest and Woodland

Conservation Status and Concern

Fire suppression combined with grazing creates conditions that support cloning of oak and invasion by conifers resulting in denser stands. Seven terrestrial SGCN are closely associated with this ecological system and nine are generally associated. A complete analysis of habitat association has not been done for SGCN anadromous and freshwater fishes.

Description and Distribution

This narrowly restricted ecological system appears at or near lower treeline in foothills of the eastern Cascade Range. Most occurrences of this system are dominated by a mix of Oregon white oak (*Quercus garryana*) and ponderosa pine or Douglas-fir. Scattered ponderosa pine or Douglas-fir comprise the upper canopy over Oregon white oak trees. Clonal Oregon white oak can create dense patches across a grassy landscape or can dominate open woodlands or savannas. Shrub-steppe vegetation may be prominent in some stands and create a distinct tree / shrub / sparse grassland habitat, including bitterbrush, big

sagebrush and yellow rabbitbrush (*Chrysothamnus viscidiflorus*). The understory is generally dominated by herbaceous species, especially graminoids (grasses, sedges, and rushes). Mesic sites have an open- to-closed sodgrass understory dominated by pinegrass (*Calamagrostis rubescens*), Geyer's sedge (*Carex geyeri*), Ross' sedge (*Carex rossii*), or blue wildrye (*Elymus glaucus*). Drier savanna and woodland understories typically contain bunchgrass steppe species such as Idaho fescue (*Festuca idahoensis*) or bluebunch wheatgrass (*Pseudoroegneria spicata*). Common exotic grasses that often appear in high abundance are cheatgrass and bulbous bluegrass.

In the Columbia River Gorge, Oregon white oak can be found in dense patches often associated with grassland or shrubland balds within a closed Douglas-fir overstory forest landscape. The understory is often shrubby and composed of deerbrush (*Ceanothus integerrimus*), oceanspray, common snowberry (*Symphoricarpos albus*), and Pacific poison oak (*Toxicodendron diversilobum*). These woodlands occur at the lower treeline/ecotone between sagebrush (*Artemisia* spp.) or bitterbrush steppe or shrubland and ponderosa pine and/or Douglas-fir forests or woodlands. The matrix system occurs in the eastern Cascades in Washington and Oregon within 40 miles of the Columbia River Gorge. Elevations range from 1500 to 6300 feet. The Washington map was based on LANDFIRE data.

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes If Snags or Logs, or Old Growth/ Mature Forest Conditions are present	S1/S2	Imperiled/ declining.	MAMMALS: American badger, Hoary bat, Silver-haired Bat, Townsend's Big-eared Bat, Western Gray Squirrel*
			BIRDS: Bald Eagle, Golden Eagle, Lewis' Woodpecker*, Pygmy Nuthatch*, White-headed Woodpecker
			AMPHIBIANS: Larch Mountain Salamander, Western Toad
			REPTILES: California Mountain Kingsnake*, Ringneck Snake*, Sharptail Snake*, Western Pond Turtle*
			FISH: to be determined- research needed

* SGCN is closely associated with this ecological system

Stressors and Actions Needed

Fire suppression may support cloning of oak and invasion by conifers resulting in denser stands. This may be exacerbated by excessive grazing. Establishment of a natural fire regime is a key conservation action.

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Altered disturbance regimes	Fire exclusion has resulted in tree and shrub encroachment.	<ul style="list-style-type: none"> Fire management Vegetation management Invasive species control 	Integrated habitat restoration using prescribed fire, weed control and seeding with natives.
Roads and development	Habitat has been lost to housing and subdivisions.	<ul style="list-style-type: none"> Environmental review Land acquisition Land use planning Private lands agreements 	Acquisitions, conservation easements, landowner agreements, and restoration.

Invasive and other problematic species	Invasive trees, forbs and shrubs are degrading habitat.	<ul style="list-style-type: none"> Invasive species control 	Mechanical and herbicide control of invasive species.
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North Pacific Dry Douglas-Fir-(Madrone) Forest and Woodland

Conservation Status and Concern

Clearcut or similar logging reduces canopy structural complexity and abundance of large woody debris. Fire suppression and climate change are significant threats to habitat for at least one SGCN species. There are 4 closely associated and 15 generally associated terrestrial SGCN that use this system. A complete analysis of habitat association has not been done for SGCN anadromous and freshwater fishes.

Description and Distribution

Large and small patch system most common in the Puget Trough - Willamette Valley but found throughout western Washington and much of western Oregon. The Washington map was based on the recent modification of Washington's GAP map for Zone 1 (i.e. west side and east slope of the Cascades). Found in dry soils within relatively dry to mesic climates in the western Cascades, it can occur up to about 4000 feet elevation. With fire exclusion, stands have probably increased in tree density and grassy understories have been replaced by deciduous shrubs. Moderate to heavy grazing or other significant ground disturbance leads to increases in non-native invasive species, many of which are now abundant in stands with grassy or formerly grassy understories. Exotic herbaceous invaders include colonial bentgrass (*Agrostis capillaris*), common velvetgrass (*Holcus lanatus*), Kentucky bluegrass (*Poa pratensis*), tall oatgrass (*Arrhenatherum elatius*), ripgut brome (*Bromus rigidus*), orchardgrass (*Dactylis glomerata*), bristly dogstail grass (*Cynosurus echinatus*), tall fescue (*Schedonorus arundinaceus*), and common St. Johnswort (*Hypericum perforatum*).

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes If Snags or Logs, or Old Growth/ Mature Forest Conditions are present	S2	Imperiled/ declining.	MAMMALS: Hoary Bat, Keen's Myotis, Shaw Island Vole, Silver-haired Bat, Townsend's Big-eared Bat, Western Gray Squirrel, Western Spotted Skunk
		Declines of 30-50% within the last 50 years.	BIRDS: Bald Eagle, Marbled Murrelet, Peregrine Falcon, Western Bluebird, Western Screech Owl
			AMPHIBIANS: Western Toad
			FISH: to be determined- research needed
		Declines of 70-80% from historical conditions.	INVERTEBRATES: Great Arctic*, Hoary Elfin*, Oregon Megomphidx, Pacific Vertigo, Puget Sound Fritillary*, Valley Silverspot*

* SGCN is closely associated with this ecological system

Stressors and Actions Needed: Maintenance of a natural fire regime is a key indicator of health

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Altered disturbance regimes	Fire exclusion has resulted in tree and shrub encroachment	<ul style="list-style-type: none"> • Fire management • Vegetation management 	Integrated habitat restoration using prescribed fire, weed control and seeding with natives
Roads and development	Habitat has been lost to housing and subdivisions	<ul style="list-style-type: none"> • Environmental review • Land acquisition • Land use planning • Private lands agreements 	Acquisitions, conservation easements, landowner agreements, and restoration
Invasive and other problematic species	Invasive trees, forbs and shrubs are degrading habitat	<ul style="list-style-type: none"> • Invasive species control 	Mechanical and herbicide control of invasive species
Forestry impacts	Clearcut or similar logging reduces canopy structural complexity and abundance of large woody debris.	<ul style="list-style-type: none"> • Environmental review • Land acquisition • Private lands agreements 	Protect key sites through acquisition, easement, and planning.

North Pacific Hypermaritime Sitka Spruce Forest

Conservation Status and Concern

Historically, this system was more extensive, and has been reduced by conversion to commercial forest and shorter forest rotation. There are 2 closely associated and 19 generally associated terrestrial SCGN that use this ecological system. A complete analysis of habitat association has not been done for SCGN anadromous and freshwater fishes.

Description and Distribution

This system is characterized by forests found in the outermost coastal fringe where salt spray is prominent and on riparian terraces and valley bottoms near the coast where there is abundant fog. Large patch system are restricted to the hypermaritime climatic areas near the Pacific Coast, along a fog belt from Point Arena, California, north to the Kenai Peninsula, Alaska. It is found below 1000 feet elevation and within 15 miles of the outer coast, and does not include swamp areas. Mild, wet climate with abundant summer fog are characteristic and annual precipitation ranges from 26 to 217 inches, with the majority falling as rain, which can be heavy. The Washington map is based on recent modification of Washington's GAP map for Zone 1 (i.e. west side and east slope of the Cascades).

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes If Snags or Logs, or Old Growth/ Mature Forest Conditions are present.	S2	Imperiled/ declining. Decline of 70-80% within last 50 years and from historical condition.	MAMMALS: Fisher, Hoary Bat, Keen's Myotis, Pacific Marten (coastal population)*, Silver-haired Bat, Townsend's Big-eared Bat, Western Spotted Skunk
			BIRDS: Bald Eagle, Golden Eagle, Harlequin Duck, Marbled Murrelet, Northern Spotted Owl, Peregrine Falcon, Western Bluebird, Western Screech Owl
			AMPHIBIANS: Cope's Giant Salamander, Dunn's Salamander*, Olympic Torrent Salamander, Van Dyke's Salamander, Western Toad
			FISH: to be determined- research needed
			INVERTEBRATES: Crowned Ttightcoil

* SCGN is closely associated with this ecological system

Stressors and Actions Needed

Many historical occurrences of this system have become conifer plantations and logging of remaining intact stands remains a threat. Clearcut logging and plantation forestry have resulted in less diverse tree canopies, and have focused mainly on Douglas-fir, with reductions in coarse woody debris, a shortened stand initiation phase, and succession truncated well before late-seral characteristics are expressed. Non-native species are also a potential threat to the persistence and ecological integrity of this ecological system. Maintenance of a natural fire regime and longer stand rotations are key conservation actions.

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Roads and development	Habitat has been lost to housing and subdivisions.	<ul style="list-style-type: none"> Environmental review Land acquisition 	Acquisitions, conservation easements, landowner agreements, and restoration.

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
		<ul style="list-style-type: none"> Land use planning Private lands agreements 	
Forestry impacts	Intensive forestry that emphasizes shorter rotations and different species.	<ul style="list-style-type: none"> Vegetation management 	Integrated Habitat Restoration with native species.
Invasive and other problematic species	Invasive trees, forbs and shrubs are degrading habitat.	<ul style="list-style-type: none"> Invasive species control 	Mechanical and herbicide control of invasive species.

North Pacific Hypermaritime Western Red-cedar Western Hemlock Forest

Conservation Status and Concern

Fire suppression and climate change are significant threats to habitat for this ecological system. There are 3 closely associated and 20 generally associated terrestrial SCGN with this ecological system. A complete analysis of habitat association has not been done for SCGN anadromous and freshwater fishes.

Description and Distribution

This is a coastal forest occurring in areas of low, gentle relief within 15 miles of the coast. Where these forests are best developed they occur in a mosaic with forested wetlands, bogs, and Sitka spruce forests (the latter in riparian areas and on steep, more productive soils). The matrix system occupies the outer coastal portions of British Columbia, southeastern Alaska, and Washington. Its center of distribution is the northern coast of British Columbia, as western redcedar (*Thuja plicata*) approaches its northernmost limit in the southern half of southeastern Alaska.

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes If Snags or Logs, or Old Growth/ Mature Forest Conditions are present	S2	Imperiled/ declining.	MAMMALS: Fisher, Hoary Bat, Keen's Myotis, Pacific Marten(coastal population), Silver-haired Bat, Townsend's Big-eared Bat, Western Spotted Skunk
		Declines of 70-80% within last 50 years.	BIRDS: Bald Eagle, Golden Eagle, Harlequin Duck, Marbled Murrelet, Northern Spotted Owl, Peregrine Falcon, Western bluebird, Western Screech Owl
		Declines of 50-70% from historical.	AMPHIBIANS: Dunn's Salamander*, Cope's Giant Salamander, Olympic Torrent Salamander, Van Dyke's Salamander, Western Toad
			FISH: to be determined- research needed
			INVERTEBRATES: Bluegray Taildropper*, Johnson's hairstreak*, Puget Oregonian

* SGCN is closely associated with this ecological system

Stressors and Actions Needed

These forests very rarely burn and are more influenced by gap disturbance processes and intense windstorms than by fire. Many historical occurrences of this system have become conifer plantations and logging of remaining intact stands remains a threat. Clearcut logging and plantation forestry have resulted in less diverse tree canopies, and have focused mainly on Douglas-fir, with reductions in coarse woody debris, a shortened stand initiation phase, and succession truncated well before late-seral characteristics are expressed. Non-native species are also a potential threat to the persistence and ecological integrity of this ecological system.

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Forestry impacts	Intensive forestry that emphasizes shorter rotations and different species.	Vegetation management	Integrated habitat restoration with native species.
Roads and development	Habitat has been lost to housing and subdivisions.	<ul style="list-style-type: none">• Environmental review• Land acquisition• Land use planning• Private lands agreements	Acquisitions, conservation easements, landowner agreements, and restoration.

North Pacific Oak Woodland

Conservation Status and Concern

Due to historical loss of habitat, and ongoing threats from invasive species and development, conservation action is critical for conservation of this ecological system and associated SGCN. There are three terrestrial SGCN species that are closely associated with this ecological system and 12 that are generally associated. A complete analysis of habitat association has not been done for SGCN anadromous and freshwater fishes.

Description and Distribution

This oak woodland is most prevalent on gravelly outwash plains in Thurston and Pierce counties but is found on dry sites that experienced frequent pre-settlement fires in other part of the Puget Trough including parts of Jefferson, Clallam, Island and San Juan Counties. This system occurs as either large or small patches. The sporadic distribution and often small patch size of component parts of this system often limits visibility of mapped occurrences, thus the map also displays the counties in which the system is known to occur. The presence of Oregon white oak either as single species patches or where mixed with conifers characterizes these woodlands. East of the Cascade Crest is a different system dominated by Oregon white oak (i.e., East Cascades Oak-Ponderosa Pine Forest and Woodland).

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes Oregon White Oak Woodlands	S1	Critically imperiled/ declining. Rate of decline unknown.	MAMMALS: Western Gray Squirrel*

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
			BIRDS: Bald Eagle, Slender-billed White-breasted Nuthatch*, Western Bluebird, Western Screech Owl
			AMPHIBIANS: Oregon Spotted Frog, Western Toad
			REPTILES: Western Pond Turtle*
			FISH: to be determined- research needed
			INVERTEBRATES: Propertius' Duskywing*, Puget Sound Fritillary*

* SGCN is closely associated with this ecological system

Stressors and Actions Needed

This ecological system is relatively limited in area and is currently declining in extent and condition. With the cessation of regular fires, many oak woodlands have been invaded by a greater density of trees that alters the structure and function of woodlands and interferes with successional dynamics such as recruitment. Some areas have been lost to urban or agriculture development. Ongoing threats include residential development, increase and spread of exotic species, and fire suppression effects. Selective logging of Douglas-fir in oak woodlands can prevent long-term loss of oak dominance. Moderate to heavy grazing can lead to an increase in non-native species, many of which are now abundant. Maintenance of a natural fire regime is a key conservation action.

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Altered disturbance regimes	Fire exclusion has resulted in tree and shrub encroachment	<ul style="list-style-type: none"> • Fire management • Vegetation management • Invasive species control 	Integrated habitat restoration using prescribed fire, weed control and seeding with native species
Roads and development	Habitat has been lost to housing and subdivisions	<ul style="list-style-type: none"> • Environmental review • Land acquisition • Land use planning • Private lands agreements 	Acquisitions, conservation easements, landowner agreements, and restoration
Invasive and other problematic species	Invasive trees, forbs and shrubs are degrading habitat	<ul style="list-style-type: none"> • Invasive species control 	Mechanical and herbicide control of invasive species

Northern Rocky Mountain Ponderosa Pine Woodland and Savanna

Conservation Status and Concern

Fire suppression and climate change are significant threats to this ecological system. Housing and development is increasingly moving into this habitat. There are 9 terrestrial SGCN that are closely associated with this ecological system and 20 that are generally associated. Although a complete analysis

has not been done for all SGCN anadromous and freshwater fishes, several appear closely associated with this system, e.g., Upper Columbia Steelhead DPS, and Upper Columbia Spring Chinook Salmon ESU.

Description and Distribution

These woodlands and savannas are, or at least historically were, fire-maintained and occur at the lower treeline/ecotone between grasslands or shrublands at lower elevations and more mesic coniferous forests at higher elevations. This is the predominant ponderosa pine system of eastern Washington. This system occurs in the foothills of the northern Rocky Mountains in the Columbia Plateau region and west along the foothills of the Modoc Plateau and eastern Cascades into southern interior British Columbia.

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes If Snags or Logs, or Old Growth/ Mature Forest Conditions are present	S2	Imperiled/ declining.	MAMMALS: American Badger, American Pika, Gray Wolf, Hoary Bat, Silver-haired Bat, Spotted Bat, Townsend's Big-eared Bat, Western Gray Squirrel
			BIRDS: Bald Eagle, Flammulated Owl*, Golden Eagle, Harlequin Duck, Lewis' Woodpecker, Mountain Quail*, Northern Spotted Owl, Peregrine Falcon, Pygmy Nuthatch*, White-headed woodpecker*
			AMPHIBIANS: Columbia Spotted Frog, Tiger Salamander, Western Toad
			REPTILES: California Mountain Kingsnake*, Night Snake, Ringneck Snake*, Sharptail Snake*, Short-horned Lizard
			FISH: to be determined- research needed
			INVERTEBRATES: Chelan Mountainsnail*, Hoder's Mountainsnail, Mardon Skipper*

* SGCN is closely associated with this ecological system

Stressors and Actions Needed

Pre-1900, this system was a mosaic of forest containing a substantial area of open and park like forest with few understory trees. Currently, much of this system has a younger tree cohort often including more shade-tolerant species, resulting in a more closed, multilayered canopy in patches that include older trees. Fire suppression has led to a buildup of fuels (e.g. higher density of trees, inter-connecting canopies of trees, multiple heights classes of trees) that in turn increase the likelihood of stand-replacing fires. Heavy grazing, in contrast to fire, removes the grass cover and tends to favor shrub and conifer species. Fire suppression combined with grazing creates conditions that support invasion by conifers. Large late-seral ponderosa pine and Douglas-fir are harvested in much of this habitat. Under most management regimes, typical tree size decreases and tree density increases in this habitat. Maintenance of a natural fire regime and longer stand rotation are key conservation actions.

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Altered disturbance regimes	Fire exclusion has resulted in tree and shrub encroachment	<ul style="list-style-type: none"> Fire management Vegetation management 	Integrated habitat restoration using prescribed fire, weed control and seeding with natives

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Fish and wildlife habitat loss or degradation	Habitat has been lost to agriculture, and development.	<ul style="list-style-type: none"> Environmental Review Land acquisition Land use planning Private lands agreements 	Acquisitions, conservation easements, landowner agreements, and restoration.
Invasive and other problematic species	Invasive trees, forbs and shrubs are degrading habitat	<ul style="list-style-type: none"> Invasive species control 	Mechanical and herbicide control of invasive species

Northern Rocky Mountain Western Larch Savanna

Conservation Status and Concern

This is a fire-dependent system and was much more extensive in the past; it is now very patchy in distribution. Fire suppression has led to invasion of the more shade-tolerant tree species grand fir (*Abies grandis*), subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*), or hemlock species (*Tsuga* spp.) and loss of much of the single-story canopy woodlands. Fire suppression and climate change are significant threats. There are 12 terrestrial SCGN species that are generally associated with this ecological system. A complete analysis of habitat association has not been done for SCGN anadromous and freshwater fishes.

Description and Distribution

This large patch system is restricted to the interior montane zone of the Pacific Northwest in northern Idaho and adjacent Montana, Washington, Oregon, and southeastern British Columbia. The Washington map is based on recent modification of Washington's GAP map for Zone 1 (i.e. east slope of the Cascades) and LANDFIRE data. The sporadic distribution of this system limits visibility of mapped occurrences, thus the map also displays the counties in which the system is known to occur. There may be remnant stands in Yakima and Klickitat counties. Elevations range from 2230 to 7200 feet, and sites include drier, lower montane settings of toe slopes and ash deposits. Winter snowpack typically melts off in early spring at lower elevations.

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes If Snags or Logs, or Old Growth /Mature Forest Conditions are present	S1	Critically imperiled/ declining.	MAMMALS: American pica, Cascade red fox, Gray wolf, Grizzly Bear, Hoary Bat, Silver-haired Bat, Townsends Big-eared Bat, Wolverine
			BIRDS: Bald Eagle, Golden Eagle, Lewis' woodpecker
			AMPHIBIANS: Columbia Spotted Frog
			REPTILES: none
			FISH: to be determined- research needed
			INVERTEBRATES: none

* SGCN is closely associated with this ecological system

Stressors and Actions Needed

This is a fire-dependent system and was much more extensive in the past; it is now very patchy in distribution. Fire suppression has led to invasion of the more shade-tolerant tree species such as grand fir, subalpine fir, Engelmann spruce, or hemlock species and loss of much of the single-story canopy woodlands. Maintenance of a natural fire regime is a key conservation action.

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Altered disturbance regimes	Fire exclusion has resulted in tree and shrub encroachment	<ul style="list-style-type: none">• Fire management• Vegetation management• Invasive species control	Integrated habitat restoration using prescribed fire, weed control and seeding with natives
Roads and development	Habitat has been lost to housing and subdivisions	<ul style="list-style-type: none">• Environmental review• Land acquisition• Land use planning• Private lands agreements	Acquisitions, conservation easements, landowner agreements, and restoration

Rocky Mountain Aspen Forest and Woodland

Conservation Status and Concern

Conifers now dominate many seral aspen stands and extensive stands of young aspen are uncommon. Heavy livestock browsing can adversely impact aspen growth and regeneration. With fire suppression and alteration of fine fuels, fire rejuvenation of aspen habitat has been greatly reduced since about 1900. There are 10 generally associated terrestrial SCGN that use this ecological system. A complete analysis of habitat association has not been done for SCGN anadromous and freshwater fishes.

Description and Distribution

Aspen forests and woodlands are a minor type found on the east side of the North Cascades and in the Okanogan. Although aspen can be associated with streams, ponds, or wetlands, this system consists of upland aspen stands found from low to moderate elevation. This widespread, large patch system is very common in the southern and central Rocky Mountains but occurs in the montane and subalpine zones throughout much of the western U.S. and north into Canada. The Washington map is based on recent modification of Washington's GAP map for Zone 1 (i.e. west side and east slope of the Cascades). The sporadic distribution of this system limits visibility of mapped occurrences, thus the map also displays the counties in which the system is known to occur. It often occurs on well-drained mountain slopes or canyon walls that have some moisture. Rockfalls, talus, or stony north slopes are often typical sites and the system may occur in steppe on moist microsites.

PHS	NHP Rank	Status and trend	SGCN closely and generally associated with this ecological system
Yes. Snags and Logs and Aspen Stands	S2	Imperiled/ declining. Declines of 50- 70% within the last 50 years.	MAMMALS: Gray Wolf, Grizzly Bear, Hoary Bat Silver-haired Bat, Townsend's Big-eared Bat
			BIRDS: Bald Eagle, Harlequin Duck, Lewis' woodpecker
			AMPHIBIANS: Columbia spotted frog , Western toad
			FISH: to be determined- research needed
			INVERTEBRATES: none

* SCGN is closely associated with this ecological system

Stressors and Actions Needed

STRESSOR	DESCRIPTION	ACTION CATEGORY	ACTION DESCRIPTION
Altered disturbance regimes	Fire exclusion has resulted in tree and shrub encroachment, loss of habitat diversity	<ul style="list-style-type: none"> Fire management Vegetation management Invasive species control 	Integrated habitat restoration using prescribed fire, weed control and seeding with natives
Roads and development	Habitat has been lost to housing and subdivisions	<ul style="list-style-type: none"> Environmental review Land acquisition Land use planning Private lands agreements 	Acquisitions, conservation easements, landowner agreements, and restoration

4.4 PUTTING IT ALL TOGETHER: PRIORITY LANDSCAPES INITIATIVE

The Priority Landscapes Initiative is a new effort intended to identify statewide priorities and provide a framework for place-based collaborative work aimed at preserving landscape conservation values throughout Washington State.

This initiative is one avenue by which the agency intends to link the conservation priorities identified for our Species of Greatest Conservation Need (SGCN), with those for our most important habitats and Ecological Systems of Concern and identify landscape level actions to benefit them. Products of the initiative will include the identification of specific geographies where landscape level conservation actions will have broad benefit across ecological systems and SGCN.

Between 2015 and 2017, WDFW intends to identify landscape level priorities statewide, and also to select two to four areas to be the near-term focus of efforts to promote collaborative conservation aimed at improving habitat conditions for wildlife.

Criteria for Priority Landscapes

The selection criteria is generally a combination of agency priorities for conservation (in part identified through the State Wildlife Action Plan), and an assessment of the readiness of local communities and constituents to engage in a place-based collaborative conservation. Specific criteria will likely include:

- Conservation benefit to SGCN/ecological systems of concern
- Priority for species recovery plans and/or a habitat connectivity priority
- Conservation partner priorities (including land trusts, conservation NGOs, federal and state partners, farming and forestry associations, tribes, etc.)
- Momentum, and political support and funding availability

Preliminary results indicate potential Priority Landscapes in marine/nearshore systems, urban/wild interface and in agriculture and forested landscapes. Our focus in the next phase of action is to develop a list of gaps (conservation needs that are still unmet in these landscapes) to focus on in the next 10 years.

4.5 REFERENCE INFORMATION

Definition of Terms

PHS (Priority Habitats and Species Program)

A species or habitat listed under the PHS program is considered to be a priority for conservation and management and requires protective measures for survival due to population status and/or tribal, recreational or commercial importance. Management recommendations have been developed for PHS habitats, and can assist landowners, managers and others in conducting land use activities in a manner that incorporates the needs of fish and wildlife. A complete list of PHS Habitats is available [here](#).

Public Ownership

Public Ownership – Property owned by government entities including cities or municipal governments, counties, state agencies, federal agencies, and tribes.

Private Ownership

Private Land Ownership – Land owned by individuals or non-government organizations.

Natural Heritage Program (more, ranking guide)

NHP Rank (Natural Heritage Program Rank)

The Washington Natural Heritage Program assigned conservation status ranks to Washington's Ecological Systems using NatureServe's Conservation Status Rank calculator. The Conservation Status Rank is a measure of an ecological system's elimination risk. The rank is calculated using a measure of eight core factors relevant to risk assessment of elimination. The factors are organized into three categories: rarity, threats, and trends. Factors are scaled and weighted and subsequently scored according to their impact on risk. Scores are combined by category resulting in an overall calculated rank, which is reviewed by the user, and a final conservation status rank is assigned. The Conservation Status Rank calculator automates the process of assigning conservation status ranks across the network thereby improving standardization of rank assignments. WDFW identified systems with S1, S1S2, and S2 as ecological systems of concern.

General references

- Supporting documents for the EIAs can be found at:
<http://www1.dnr.wa.gov/nhp/refdesk/communities/eia.html>
- Documentation about Ecological Systems can be found at:
http://www1.dnr.wa.gov/nhp/refdesk/communities/ecol_systems.html

Specific citations used in text

- Altman, B., M. Hayes, S. Janes, and R. Forbes. 2001. Wildlife of westside grassland and chaparral habitats. Pages 261-291 in D. H. Johnson and T. A. O'Neil, Managing Directors. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, Oregon.
- Block, W.M. and L.A. Brennan. 1993. The habitat concept in ornithology: theory and applications. *Current Ornithology* 11:35-91.
- Caplow, F., and J. Miller. 2004. Southwestern Washington prairies: using GIS to find rare plant habitat in historic prairies. Washington Department of Natural Resources, Olympia, Washington.
- Chappell, C. B., and J. Kagan. 2001. Westside riparian-wetlands. Pages 94-96 in D. H. Johnson, and T. A. O'Neil, Managing Directors. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, Oregon.
- Chappell, C. B., E. A. Alverson, and W. R. Erickson. 2004. Ecologic and geographic variation in species composition of prairies, herbaceous balds, and oak woodlands of the Willamette Valley-Puget Trough-Georgia Basin Ecoregion. Abstract: Ecological Society of America, August 1 - 6, 2004, Portland Convention Center, Oregon.
- Chappell, C.B. 2006. Plant Associations of Balds and Bluffs of western Washington. Washington Natural Heritage Program, Department of Natural Resources, Olympia, WA. Online:
<http://www1.dnr.wa.gov/nhp/refdesk/communities/index.html>
- Crawford, R.C., and H. Hall. 1997. In Dunn, P.V. and K. Ewing. Ecology and Conservation of the South Puget Sound Prairie Landscape. The Nature Conservancy, Seattle, WA.
- Dahl, T. E. 1990. Wetland losses in the United States 1780's to 1980's. U. S. Fish and Wildlife Service, Washington, DC, USA.
- Easterly, R. T., D. L. Salstrom, and C. B. Chappell. 2005. Wet prairie swales of the South Puget Sound, Washington. Report prepared for The Nature Conservancy, South Sound Office, Olympia, Washington.
- Edelman, A. J. 2003. *Marmota olympus*. Mammalian Species 736: 1-5.
- Edge, W. D. 2001. Wildlife of Agriculture, Pastures, and Mixed Environs. Pages 342-360 in D. H. Johnson, and T. A. O'Neil, editors. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, OR.
- Faber-Langendoen, D., J. Nichols, L. Master, K. Snow, A. Tomaino, R. Bittman, G. Hammerson, B. Heidel, L. Ramsay, A. Teucher, and B. Young. 2012. NatureServe Conservation Status Assessments: Methodology for Assigning Ranks. NatureServe, Arlington VA.
- Federal Geographic Data Committee. 2008. National Vegetation Classification Standard, Version 2. FGDC-STD-005-2008.
- Federal Geographic Data Committee. 2012. Coastal and Marine Ecological Classification Standard. FGDC-STD-018-2012.
- Ferguson, H. L., K. Robinette, K. Stenberg. 2001. Wildlife of urban habitats. Pages 317-341 in D. H. Johnson and T. A. O'Neil, Managing Directors. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, Oregon.
- Johnson, and T. A. O'Neil, editors. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, OR.

- Fresh K., M. Dethier, C. Simenstad, M. Logsdon, H. Shipman, C. Tanner, T. Leschine, T. Mumford, G. Gelfenbaum, R. Shuman, and J. Newton. 2011. Implications of Observed Anthropogenic Changes to the Nearshore Ecosystems in Puget Sound. Prepared for the Puget Sound Nearshore Ecosystem Restoration Project. Technical Report 2011-03.
- Hallock, L. A., R. D. Haugo, and R. Crawford. 2007. Conservation strategy for Washington State inland sand dunes. Natural Heritage Report 2007-05. Prepared for the Bureau of Land Management. Washington Department of Natural Resources. Olympia, Washington.
- Hallock, L. A., and K. R. McAllister. 2009. American Bullfrog. Washington Herp Atlas. <http://www1.dnr.wa.gov/nhp/refdesk/herp/>
- Hultine, K. R., S. E. Bush, and J. R. Ehleringer. 2010. Ecophysiology of riparian cottonwood and willow before, during, and after two years of soil water removal. *Ecological Applications* 20:347-361.
- Johnson, D.H. 1980. The comparison of usage and availability measurements for evaluating resource preference. *Ecology* 61:65-71.
- Johnson, D. H., and T. A. O'Neil. 2001. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, Oregon
- Kauffman, J. B., A. S. Thorpe, and E. N. J. Brookshire. 2004. Livestock exclusion and belowground ecosystem responses in riparian meadows of Eastern Oregon. *Ecological Applications* 14: 1671-1679.
- Kauffman, J. B., M. Mahrt, L. A. Mahrt, and W. D. Edge. 2001. Wildlife of riparian habitats. Pages 361-388 in D. H. Johnson, and T. A. O'Neil, editors. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, Oregon.
- Knutson, K. L., and V. L. Naef. 1997. Management recommendations for Washington's priority habitats: riparian. Washington Department of Fish and Wildlife, Olympia, Washington.
- Kovalchik, B. L., and R. R. Clausnitzer. 2004. Classification and management of aquatic, riparian, and wetland sites on the national forests of eastern Washington: series description. USDA Forest Service General Technical Report PNW-GTR-593. Portland, Oregon.
- Linders, M. J., W. M. Vander Haegen, J. M. Azerrad, R. Dobson, and T. Labbe. 2010. Management Recommendations for Washington's Priority Species: Western Gray Squirrel. Washington Department of Fish and Wildlife, Olympia, Washington.
- MacKenzie, W. H., and J. R. Moran. 2004. Wetlands of British Columbia: a guide to identification. Research Branch, B.C. Ministry of Forestry, Victoria, British Columbia.
- Marcoe, K., and S. Pilson. 2012. Land cover change in the Lower Columbia River Estuary, 1880 – 2011. Poster presented at The Columbia River Estuary Conference. May 15 to 17, 2012, Astoria, Oregon.
- Master, L., D. Faber-Langendoen, R. Bittman, G. A. Hammerson, B. Heidel, J. Nichols, L. Ramsay, and A. Tomaino (2009). NatureServe conservation status assessments: factors for assessing extinction risk. NatureServe, Arlington, Virginia.
- Mayor, S.J., D.C. Schneider, J.A. Schaefer, and S.P. Mahoney. 2009. Habitat selection at multiple scales. *Ecoscience* 16:238-247.
- O'Neil, editors. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, OR.
- Perry, L. G., D. C. Andersen, L. V. Reynolds, S. M. Nelson, and P. B. Shafroth. 2012. Vulnerability of riparian ecosystems to elevated CO₂ and climate change in arid and semiarid western North America. *Global Change Biology* 18: 821-842.
- Poff, B. K., A. Karen, D. G. Neary, and V. Henderson. 2011. Threats to Riparian Ecosystems in Western North America: An Analysis of Existing Literature. *Journal of the American Water Resources Association* 47:1241-1254.
- Pollock, M. M., T. J. Beechie, and C. E. Jordan. 2007. Geomorphic changes upstream of beaver dams in Bridge Creek, an incised stream channel in the interior Columbia River basin, eastern Oregon. *Earth Surface Processes and Landforms* 32: 1174-1185.
- Rocchio, J. and R. Crawford. 2008. Draft Field Guide to Washington's Ecological Systems. Washington Department of Natural Resources.
- Sarr, D. A. 2002. Riparian livestock enclosure research in the western United States: a critique and some recommendations. *Environmental Management* 30: 516-526.
- Schroeder, M. A. 2005. White-tailed ptarmigan. Page 68 in T. R. Wahl, B. Tweit, and S. G. Mlodinow, editors. Birds of Washington. Oregon State University Press, Corvallis, Oregon.

- Schroeder, M. A. and W. M. Vander Haegen. 2011. Response of greater sage-grouse to the Conservation Reserve Program in Washington State. *Studies in Avian Biology* 38:517-529.
- Tisdale, E.W. 1986. Canyon grasslands and associated shrublands of west-central Idaho and adjacent areas. Bulletin No. 40. Forestry, Wildlife and Range Experiment Station, University of Idaho, Moscow.
- Trimble, S. W., and A. C. Mendel. 1995. The cow as a geomorphic agent: a critical review. *Geomorphology* 13: 233-253.
- Vander Haegen, W. M., M. A. Schroeder, W. Y. Chang, and S. M. Knapp. 2015. Avian abundance and reproductive success in the intermountain west: Local-scale response to the conservation reserve program. *Wildlife Society Bulletin* (In Press).
- Washington Department of Fish and Wildlife (WDFW). 2009. Wildlife in a developing landscape. Pages 1-1 to 1-3 *in* Landscape planning for Washington's wildlife: managing for biodiversity in developing areas. J. Azerrad, J. Carleton, J. Davis, T. Quinn, C. Sato, M. Tihri, S. Tomassi, G. Wilhere, authors. WDFW, Olympia, Washington.
- Washington Department of Fish and Wildlife (WDFW). 2008. Priority Habitat and Species List. Olympia, Washington. 177 pp.
- Washington Office of Financial Management. 2014. State of Washington forecast of the state population: November 2014 forecast.
- Wissmar, R. C. 2004. Riparian corridors of eastern Oregon and Washington: functions and sustainability along lowland-arid to mountain gradients. *Aquatic Sciences* 66: 373-387

Crosswalk between Formations, Ecological Systems and PHS¹ Categories

Table 4-6: National Vegetation Classification/PHS Crosswalk

Formation	Ecological System	ESOC ²	Associated PHS Habitat	Conditional Riparian Habitat
Alpine Cliff, Scree & Rock Vegetation	North Pacific Alpine and Subalpine Bedrock and Scree	no	see "Conditional Riparian Habitat" column	Talus
	Rocky Mountain Alpine Bedrock and Scree	no	see "Conditional Riparian Habitat" column	Talus
	North Pacific Dry and Mesic Alpine Dwarf-Shrubland, Fell-field and Meadow	no	none	N/A
	Rocky Mountain Alpine Fell-Field	no	none	N/A
	Rocky Mountain Alpine Tundra/Fell-field/Dwarf-shrub Map Unit	no	none	N/A
Barren	North American Alpine Ice Field	no	none	N/A
	Unconsolidated Shore	no	none (Riparian?)	N/A
Bog & Fen	North Pacific Bog and Fen	yes	Freshwater Wetlands and Fresh Deepwater	N/A
	Rocky Mountain Subalpine-Montane Fen	no	Freshwater Wetlands and Fresh Deepwater	N/A
Cliff, Scree & Rock Vegetation	North Pacific Montane Massive Bedrock, Cliff and Talus	no	Talus	N/A
	Rocky Mountain Cliff, Canyon and Massive Bedrock	no	see "Conditional Riparian Habitat" column	Cliffs
Current and Historic Mining Activity	Quarries, Mines, Gravel Pits and Oil Wells	no	none	N/A

¹ Priority Habitats and Species

² Ecological System of Concern

Formation	Ecological System	ESOC ²	Associated PHS Habitat	Conditional Riparian Habitat
Developed & Urban	Developed, High Intensity	no	none	N/A
	Developed, Low Intensity	no	none	N/A
	Developed, Medium Intensity	no	none	N/A
	Developed, Open Space	no	none	N/A
Flooded and Swamp Forest	Columbia Basin Foothill Riparian Woodland and Shrubland	yes	Riparian	N/A
	Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland	no	Riparian	N/A
	Inter-Mountain Basins Montane Riparian Systems	no	Riparian	N/A
	North Pacific Hardwood-Conifer Swamp	yes	Freshwater Wetlands and Fresh Deepwater	N/A
	North Pacific Lowland Riparian Forest and Shrubland	yes	Riparian	N/A
	North Pacific Montane Riparian Woodland and Shrubland	no	Riparian	N/A
	North Pacific Shrub Swamp	no	Freshwater Wetlands and Fresh Deepwater	N/A
	Northern Rocky Mountain Conifer Swamp	no	Freshwater Wetlands and Fresh Deepwater	N/A
	Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland	yes	Riparian	N/A
	Rocky Mountain Lower Montane Riparian Woodland and Shrubland	no	Riparian	N/A
	Rocky Mountain Subalpine-Montane Riparian Woodland	no	Riparian	N/A

Formation	Ecological System	ESOC ²	Associated PHS Habitat	Conditional Riparian Habitat
Freshwater Aquatic Vegetation	Temperate Pacific Freshwater Aquatic Bed	no	Freshwater Wetlands and Fresh Deepwater	N/A
Freshwater Wet Meadow & Marsh	Columbia Plateau Vernal Pool	no	Freshwater Wetlands and Fresh Deepwater	N/A
	North American Arid West Emergent Marsh	yes	Freshwater Wetlands and Fresh Deepwater	N/A
	North Pacific Avalanche Chute Shrubland	no	none	N/A
	North Pacific Intertidal Freshwater Wetland	yes	Freshwater Wetlands and Fresh Deepwater	N/A
	Rocky Mountain Alpine-Montane Wet Meadow	no	Freshwater Wetlands and Fresh Deepwater?	N/A
	Rocky Mountain Subalpine-Montane Riparian Shrubland	no	Riparian	N/A
	Temperate Pacific Freshwater Emergent Marsh	yes	Freshwater Wetlands and Fresh Deepwater	N/A
	Temperate Pacific Freshwater Mudflat	yes	Freshwater Wetlands and Fresh Deepwater	N/A
	Temperate Pacific Montane Wet Meadow	no	Freshwater Wetlands and Fresh Deepwater	N/A
	Willamette Valley Wet Prairie	yes	Westside Prairie	N/A
Grassland, Meadow & Shrubland	Columbia Basin Foothill and Canyon Dry Grassland	yes	none (Eastside Steppe?)	N/A
	Columbia Basin Palouse Prairie	yes	Eastside Steppe	N/A
	North Pacific Alpine and Subalpine Dry Grassland	no	none	N/A
	North Pacific Herbaceous Bald and Bluff	no	Herbaceous Bald	N/A

Formation	Ecological System	ESOC ²	Associated PHS Habitat	Conditional Riparian Habitat
	North Pacific Hypermaritime Shrub and Herbaceous Headland	no	Nearshore - Open Coast	N/A
	North Pacific Montane Shrubland	no	none	N/A
	Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland	no	none (Eastside Steppe?)	N/A
	Northern Rocky Mountain Montane-Foothill Deciduous Shrubland	no	none	N/A
	Northern Rocky Mountain Subalpine Deciduous Shrubland	no	none	N/A
	Northern Rocky Mountain Subalpine-Upper Montane Grassland	no	none (Eastside Steppe?)	N/A
	Rocky Mountain Subalpine-Montane Mesic Meadow	no	none	N/A
	Willamette Valley Upland Prairie and Savanna	yes	Westside Prairie	N/A
Herbaceous Agricultural Vegetation	Cultivated Cropland	no	none	N/A
	Pasture/Hay	no	none	N/A
Introduced & Semi Natural Vegetation	Introduced Riparian and Wetland Vegetation	no	Riparian; Freshwater Wetlands and Fresh Deepwater	N/A
	Introduced Upland Vegetation - Annual Grassland	no	none	N/A
	Introduced Upland Vegetation - Perennial Grassland and Forbland	no	none	N/A
	Introduced Upland Vegetation - Shrub	no	none	N/A
Marine & Estuarine Saltwater Aquatic	North Pacific Maritime Eelgrass Bed	no	Nearshore - Open Coast; Nearshore - Coastal; Nearshore - Puget Sound	N/A

Formation	Ecological System	ESOC ²	Associated PHS Habitat	Conditional Riparian Habitat
Vegetation	Temperate Pacific Intertidal Mudflat	no	Nearshore - Open Coast; Nearshore - Coastal; Nearshore - Puget Sound	N/A
Open Water	Open Water (Fresh)	no	see "Conditional Riparian Habitat" column	Freshwater Wetlands and Fresh Deepwater;
Recently Disturbed or Modified	Disturbed, Non-specific	no	none	N/A
	Harvested Forest - Grass/Forb Regeneration	no	none	N/A
	Harvested Forest - Northwestern Conifer Regeneration	no	none	N/A
	Harvested Forest-Shrub Regeneration	no	none	N/A
	Recently burned forest	no	see "Conditional Riparian Habitat" column	Snags and logs
	Recently burned grassland	no	none	N/A
	Recently burned shrubland	no	none	N/A
Salt Marsh	Inter-Mountain Basins Alkaline Closed Depression	yes	Freshwater Wetlands and Fresh Deepwater	N/A
	Inter-Mountain Basins Greasewood Flat	yes	none	N/A
	Inter-Mountain Basins Playa	no	none	N/A
	Temperate Pacific Tidal Salt and Brackish Marsh	yes	Nearshore - Coastal; Nearshore - Puget Sound	N/A
Scrub & Herb Coastal Vegetation	North Pacific Coastal Cliff and Bluff	no	Nearshore - Open Coast; see "Conditional Riparian Habitat" column	Cliffs

Formation	Ecological System	ESOC ²	Associated PHS Habitat	Conditional Riparian Habitat
	North Pacific Maritime Coastal Sand Dune and Strand	yes	Nearshore - Coastal; Nearshore - Puget Sound	N/A
Semi-Desert Cliff, Scree & Rock Vegetation	Columbia Plateau Ash and Tuff Badland	no	none	N/A
	Inter-Mountain Basins Active and Stabilized Dune	yes	Inland Dunes	N/A
	Inter-Mountain Basins Cliff and Canyon	no	see "Conditional Riparian Habitat" column	Cliffs; Talus
Semi-Desert Scrub & Grassland	Columbia Plateau Low Sagebrush Steppe	yes	Shrub-steppe	N/A
	Columbia Plateau Scabland Shrubland	no	none (Shrub-steppe?)	N/A
	Columbia Plateau Steppe and Grassland	yes	Eastside Steppe	N/A
	Inter-Mountain Basins Big Sagebrush Shrubland	no	none (Shrub-steppe?)	N/A
	Inter-Mountain Basins Big Sagebrush Steppe	yes	Shrub-steppe	N/A
	Inter-Mountain Basins Mixed Salt Desert Scrub	no	none (Shrub-steppe?)	N/A
	Inter-Mountain Basins Montane Sagebrush Steppe	no	Shrub-steppe	N/A
	Inter-Mountain Basins Semi-Desert Grassland	no	none (Eastside Steppe?)	N/A
	Inter-Mountain Basins Semi-Desert Shrub Steppe	yes	Shrub-steppe	N/A
Temperate Forest	Columbia Plateau Western Juniper Woodland and Savanna	no	see "Conditional Riparian Habitat" column	Juniper Savannah
	East Cascades Mesic Montane Mixed-Conifer Forest and Woodland	no	see "Conditional Riparian Habitat" column	Old Growth - Mature Forest; Snags and Logs
	East Cascades Oak-Ponderosa Pine Forest and Woodland	yes	see "Conditional Riparian Habitat" column	Old Growth - Mature Forest; Snags and Logs;

Formation	Ecological System	ESOC ²	Associated PHS Habitat	Conditional Riparian Habitat
	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	no	Aspen Stands	N/A
	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland	no	none	N/A
	Middle Rocky Mountain Montane Douglas-fir Forest and Woodland	no	see "Conditional Riparian Habitat" column	Old Growth - Mature Forest; Snags and Logs
	North Pacific Broadleaf Landslide Forest and Shrubland	no	none	N/A
	North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland	yes	see "Conditional Riparian Habitat" column	Old Growth - Mature Forest; Snags and Logs
	North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest	no	see "Conditional Riparian Habitat" column	Old Growth - Mature Forest; Snags and Logs
	North Pacific Hypermaritime Sitka Spruce Forest	yes	see "Conditional Riparian Habitat" column	Old Growth - Mature Forest; Snags and Logs
	North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest	yes	see "Conditional Riparian Habitat" column	Old Growth - Mature Forest; Snags and Logs
	North Pacific Lowland Mixed Hardwood-Conifer Forest and Woodland	no	see "Conditional Riparian Habitat" column	Old Growth - Mature Forest; Snags and Logs
	North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	no	see "Conditional Riparian Habitat" column	Old Growth - Mature Forest; Snags and Logs
	North Pacific Maritime Mesic Subalpine Parkland	no	see "Conditional Riparian Habitat" column	Old Growth - Mature Forest; Snags and Logs
	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	no	see "Conditional Riparian Habitat" column	Old Growth - Mature Forest; Snags and Logs
	North Pacific Mesic Western Hemlock-Silver Fir Forest	no	see "Conditional Riparian Habitat" column	Old Growth - Mature Forest; Snags and Logs
	North Pacific Mountain Hemlock Forest	no	see "Conditional Riparian Habitat" column	Old Growth - Mature Forest; Snags and Logs
	North Pacific Oak Woodland	yes	Oregon White Oak Woodlands; see "Conditional Riparian Habitat" column	Old Growth - Mature Forest; Snags and Logs

Formation	Ecological System	ESOC ²	Associated PHS Habitat	Conditional Riparian Habitat
Temperate Forest	North Pacific Wooded Volcanic Flowage	no	none	N/A
	Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest	no	see "Conditional Riparian Habitat" column	Old Growth - Mature Forest; Snags and Logs
	Northern Rocky Mountain Mesic Montane Mixed Conifer Forest	no	see "Conditional Riparian Habitat" column	Old Growth - Mature Forest; Snags and Logs
	Northern Rocky Mountain Ponderosa Pine Woodland and Savanna	yes	none	N/A
	Northern Rocky Mountain Subalpine Woodland and Parkland	no	none	N/A
	Northern Rocky Mountain Western Larch Savanna	yes	none	N/A
	Rocky Mountain Aspen Forest and Woodland	yes	Aspen Stands	N/A
	Rocky Mountain Lodgepole Pine Forest	no	see "Conditional Riparian Habitat" column	Old Growth - Mature Forest; Snags and Logs
	Rocky Mountain Poor-Site Lodgepole Pine Forest	no	see "Conditional Riparian Habitat" column	Old Growth - Mature Forest; Snags and Logs
	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	no	see "Conditional Riparian Habitat" column	Old Growth - Mature Forest; Snags and Logs
	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	no	see "Conditional Riparian Habitat" column	Old Growth - Mature Forest; Snags and Logs